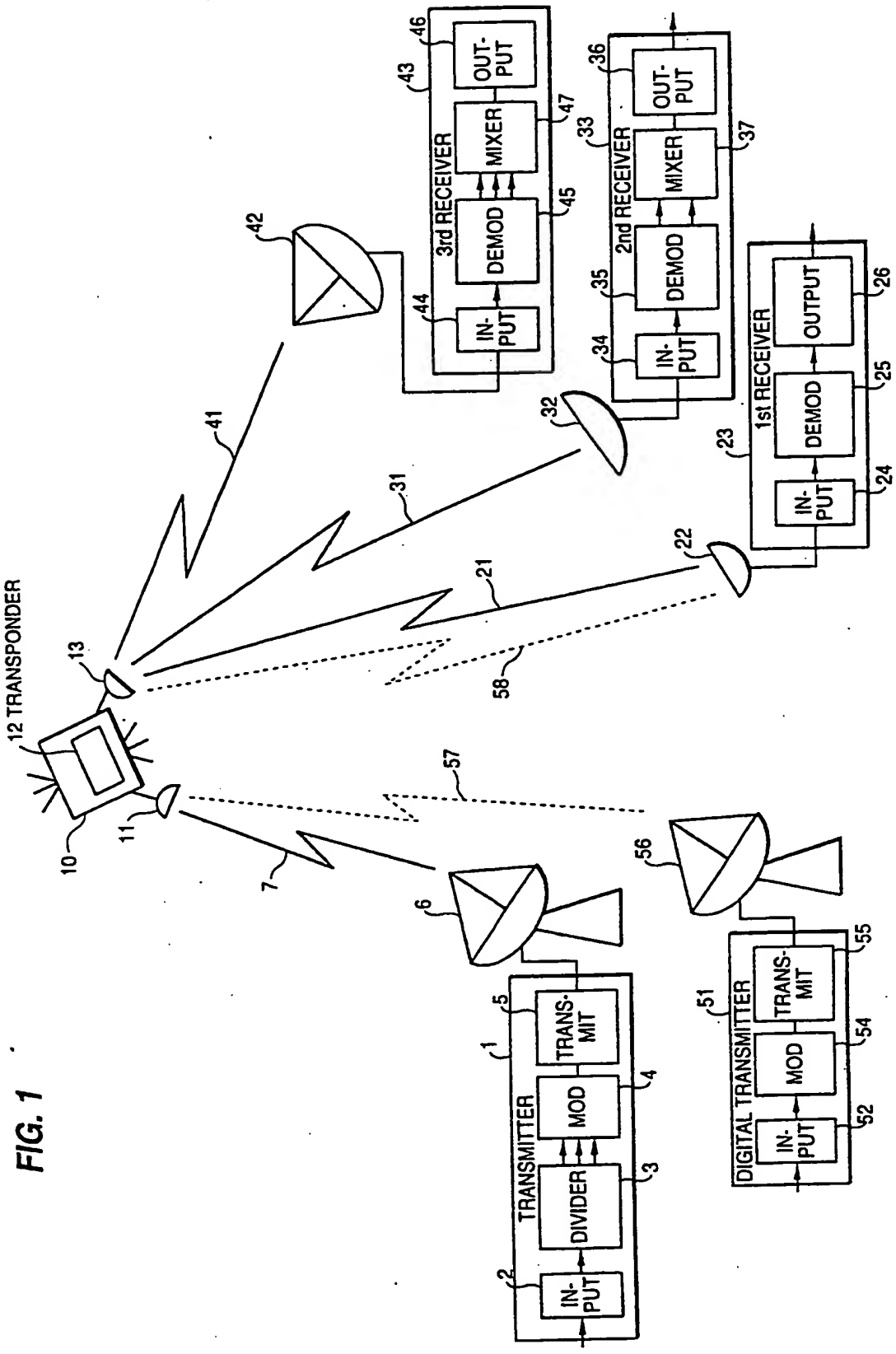

12 TRANSPONDER
13
10
11
7
6
TRANSMITTER
IN-PUT
DIVIDER
MOD
TRANS-MIT
1
2
3
4
5
DIGITAL TRANSMITTER
IN-PUT
MOD
TRANS-MIT
51
52
54
55
56
57
58
41
42
3rd RECEIVER
IN-PUT
DEMOD
MIXER
OUT-PUT
43
44
45
47
46
31
32
2nd RECEIVER
IN-PUT
DEMOD
MIXER
OUT-PUT
33
34
35
37
36
21
22
1st RECEIVER
IN-PUT
DEMOD
OUTPUT
23
24
25
26

FIG. 1

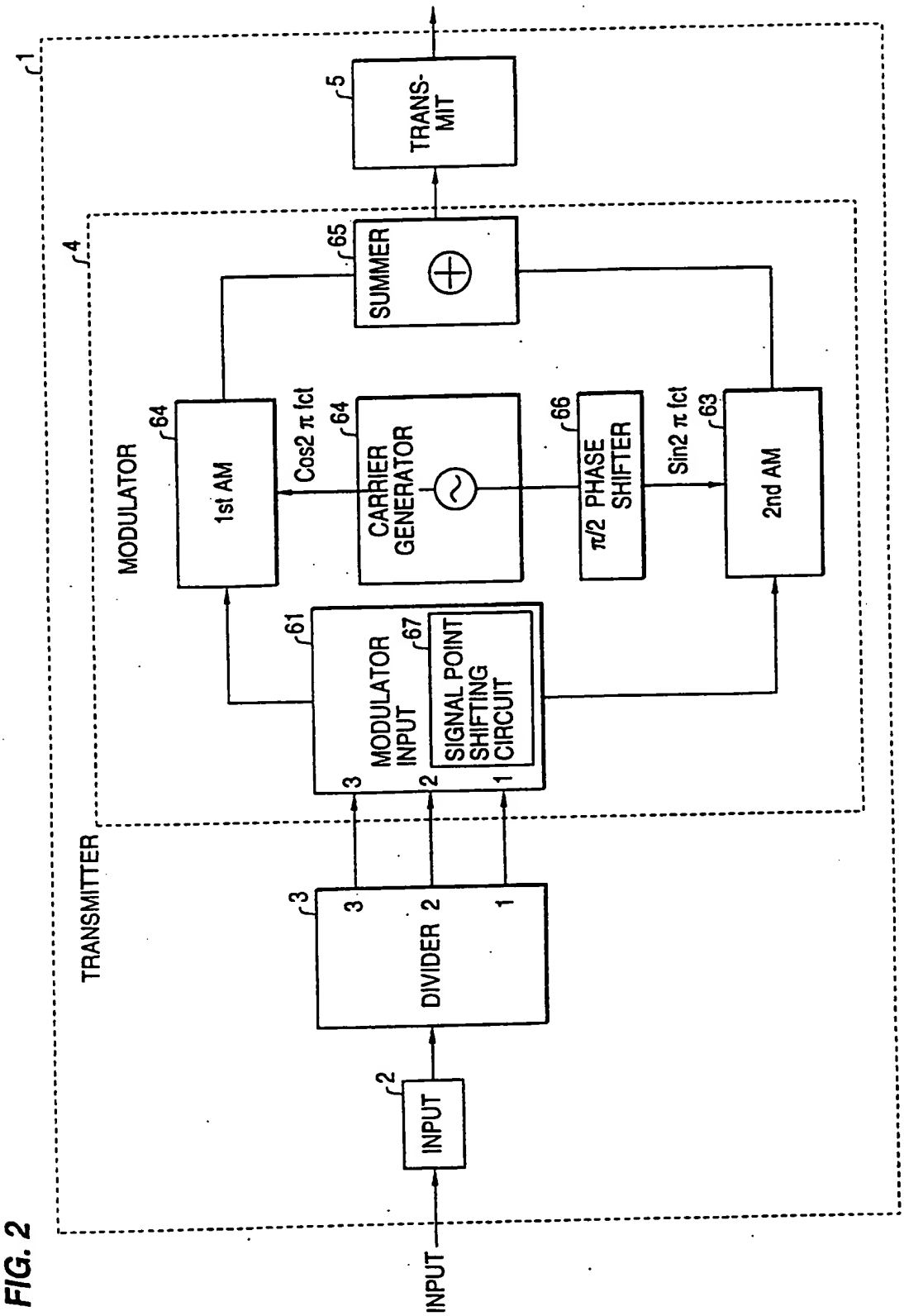

1
TRANSMITTER
2
INPUT
3
DIVIDER
3
2
1
4
MODULATOR
61
MODULATOR INPUT
67
SIGNAL POINT SHIFTING CIRCUIT
64
1st AM
Cos2 π fct
64
CARRIER GENERATOR
66
π/2 PHASE SHIFTER
Sin2 π fct
63
2nd AM
65
SUMMER
5
TRANS-MIT
INPUT

FIG. 2

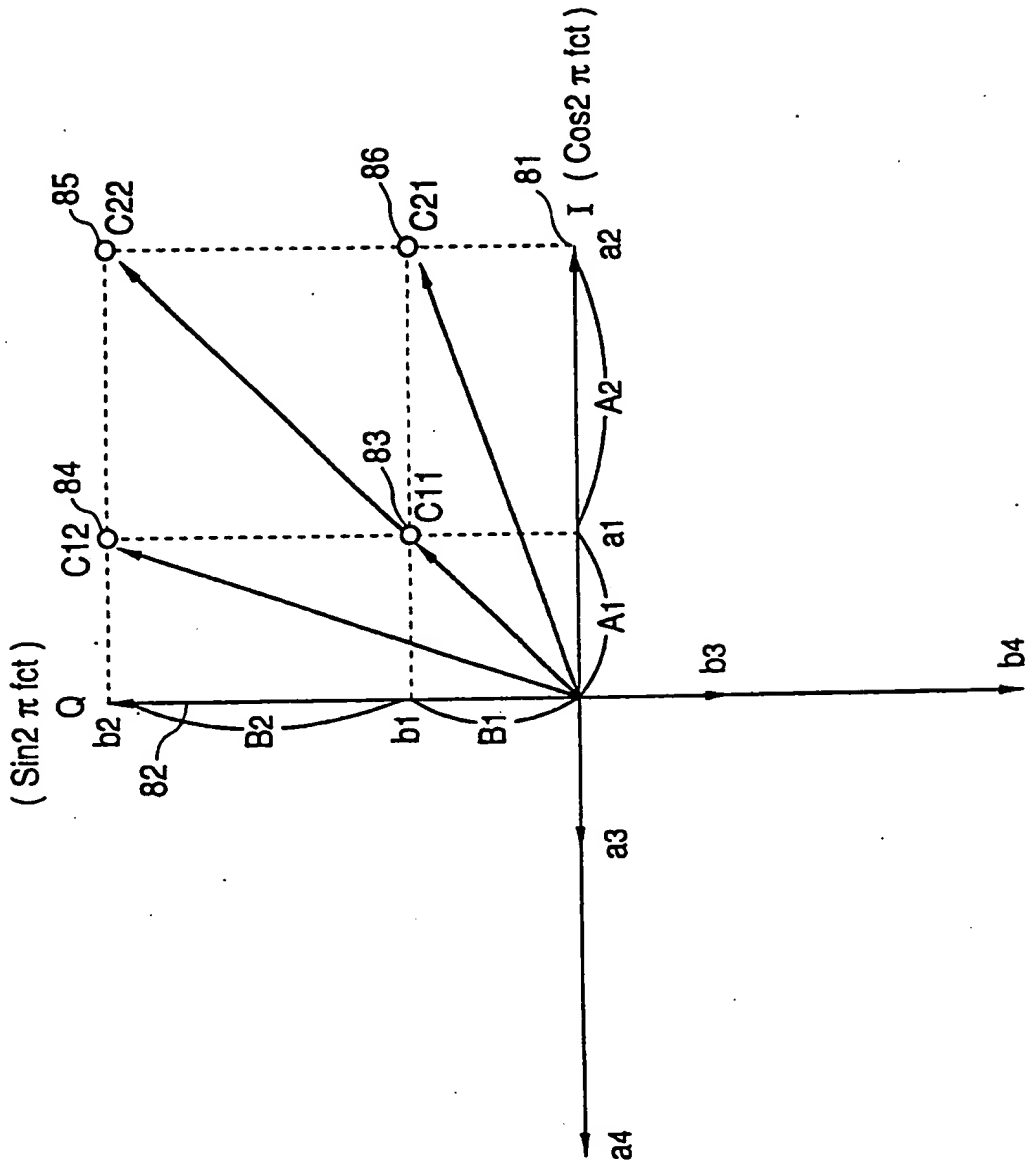

I (Cos2 π fct)
Q
(Sin2 π fct)
81
82
83
84
85
86
C11
C12
C21
C22
A1
A2
B1
B2
a1
a2
a3
a4
b1
b2
b3
b4

FIG. 3

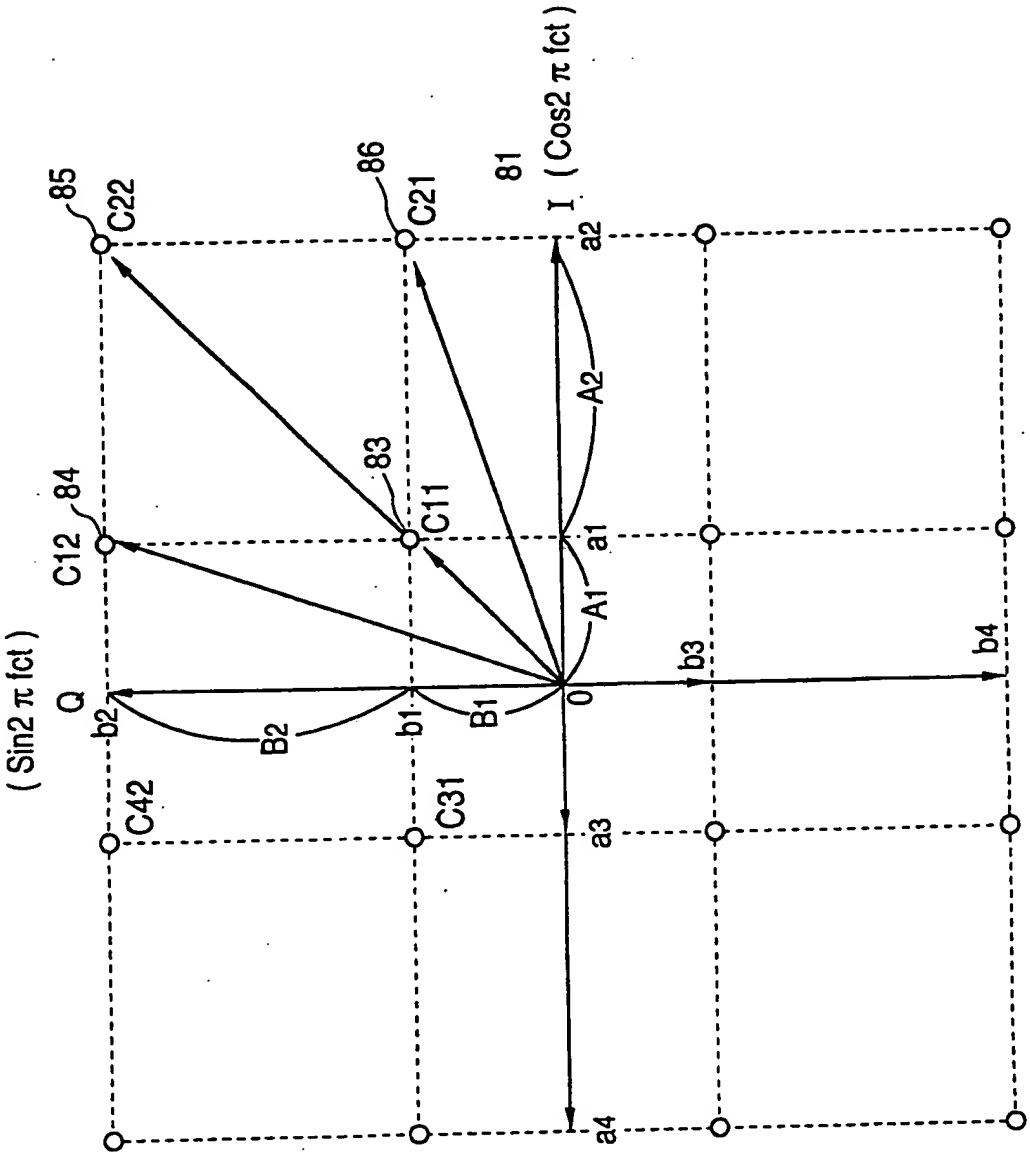

(Sin2 π fct)
Q
I (Cos2 π fct)
81
85
C22
86
C21
84
C12
83
C11
C42
C31
a1
a2
a3
a4
A1
A2
B1
B2
b1
b2
b3
b4
0

FIG. 4

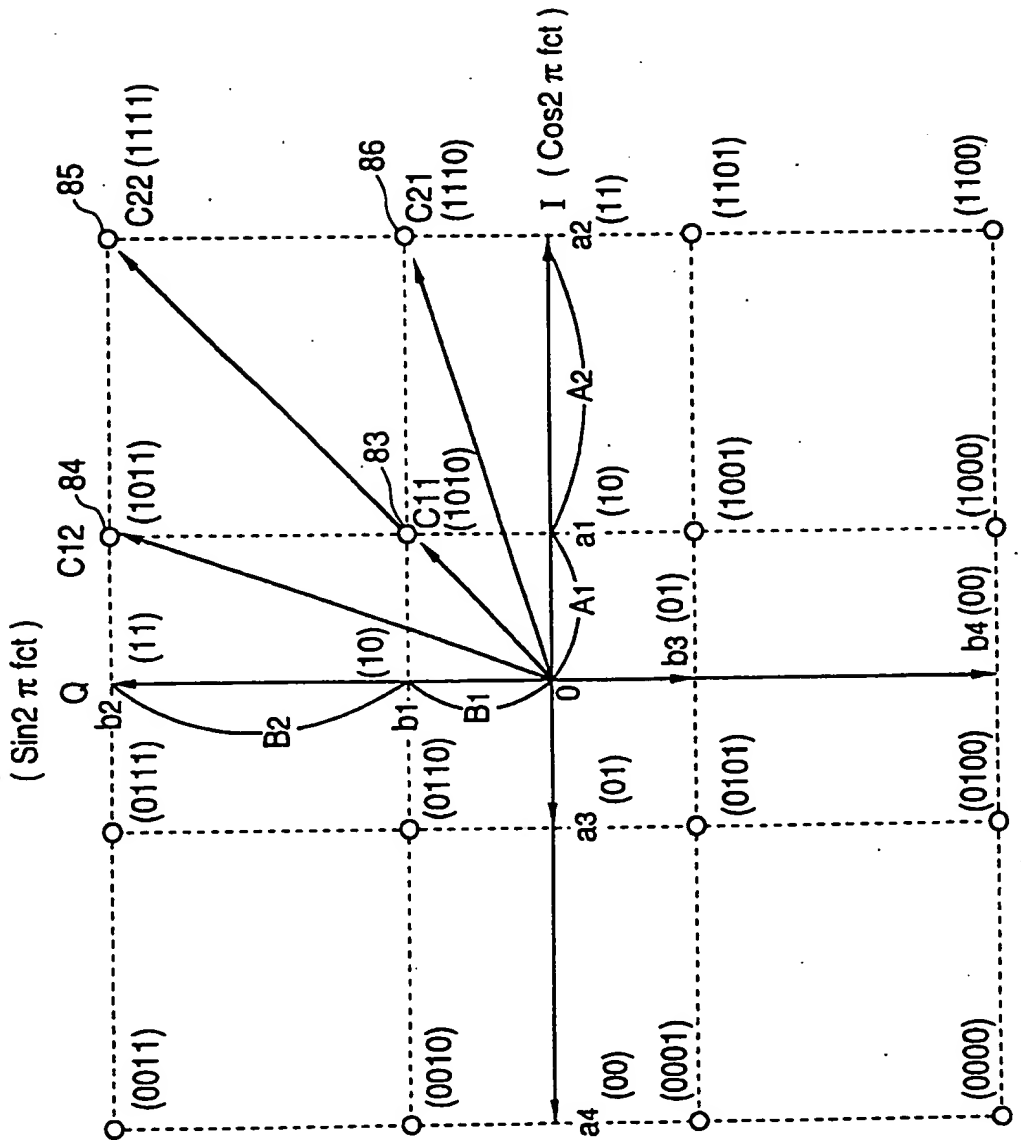

(Sin2 π fct)
Q
(Cos2 π fct)
I
0
C22 (1111)
C21 (1110)
C12
C11 (1010)
(1011)
(1101)
(1100)
(1001)
(1000)
(0111)
(0110)
(0101)
(0100)
(0011)
(0010)
(0001)
(0000)
(11)
(10)
(01)
(00)
85
86
84
83
A1
A2
B1
B2
a1
a2
a3
a4
b1
b2
b3
b4

FIG. 5

FIG. 6

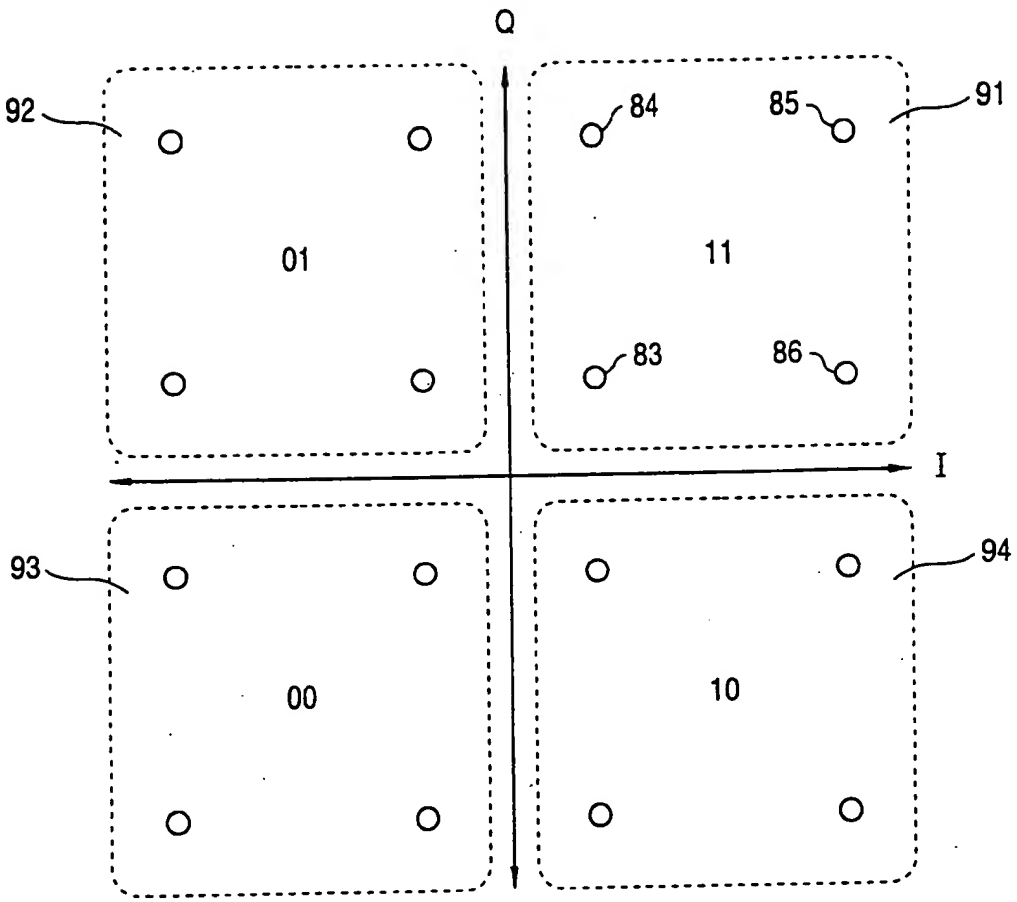


FIG. 7

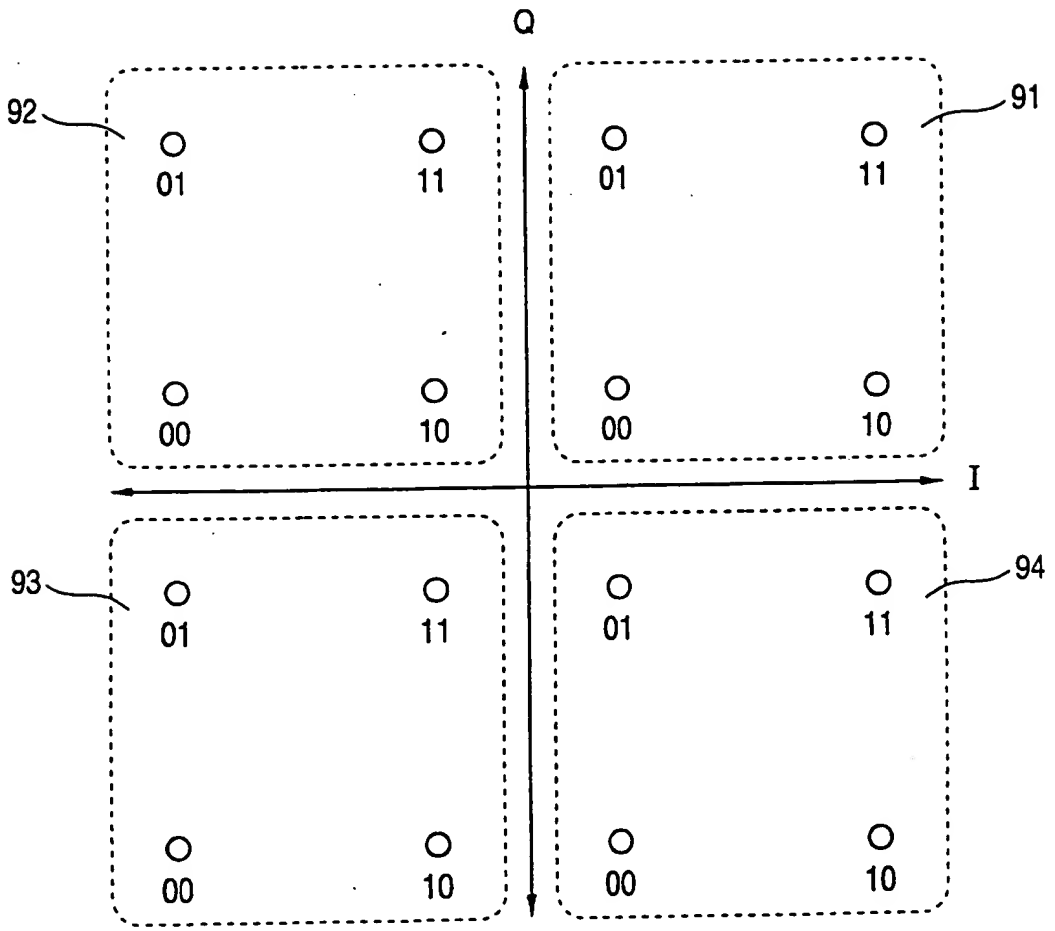
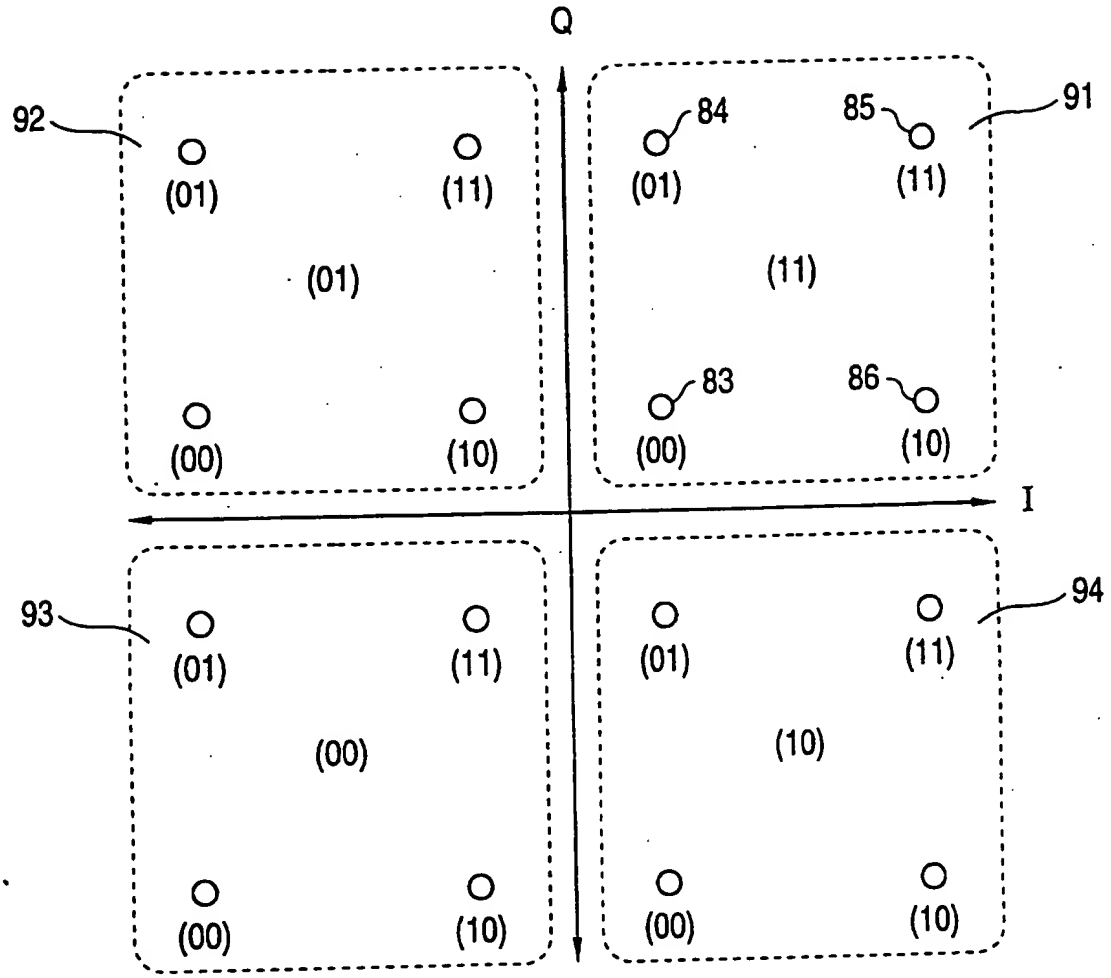


FIG. 8


Q
I
92
(01)
(11)
(01)
(00)
(10)
84
85
91
(01)
(11)
(11)
83
86
(00)
(10)
93
(01)
(11)
(00)
(00)
(10)
94
(01)
(11)
(10)
(00)
(10)

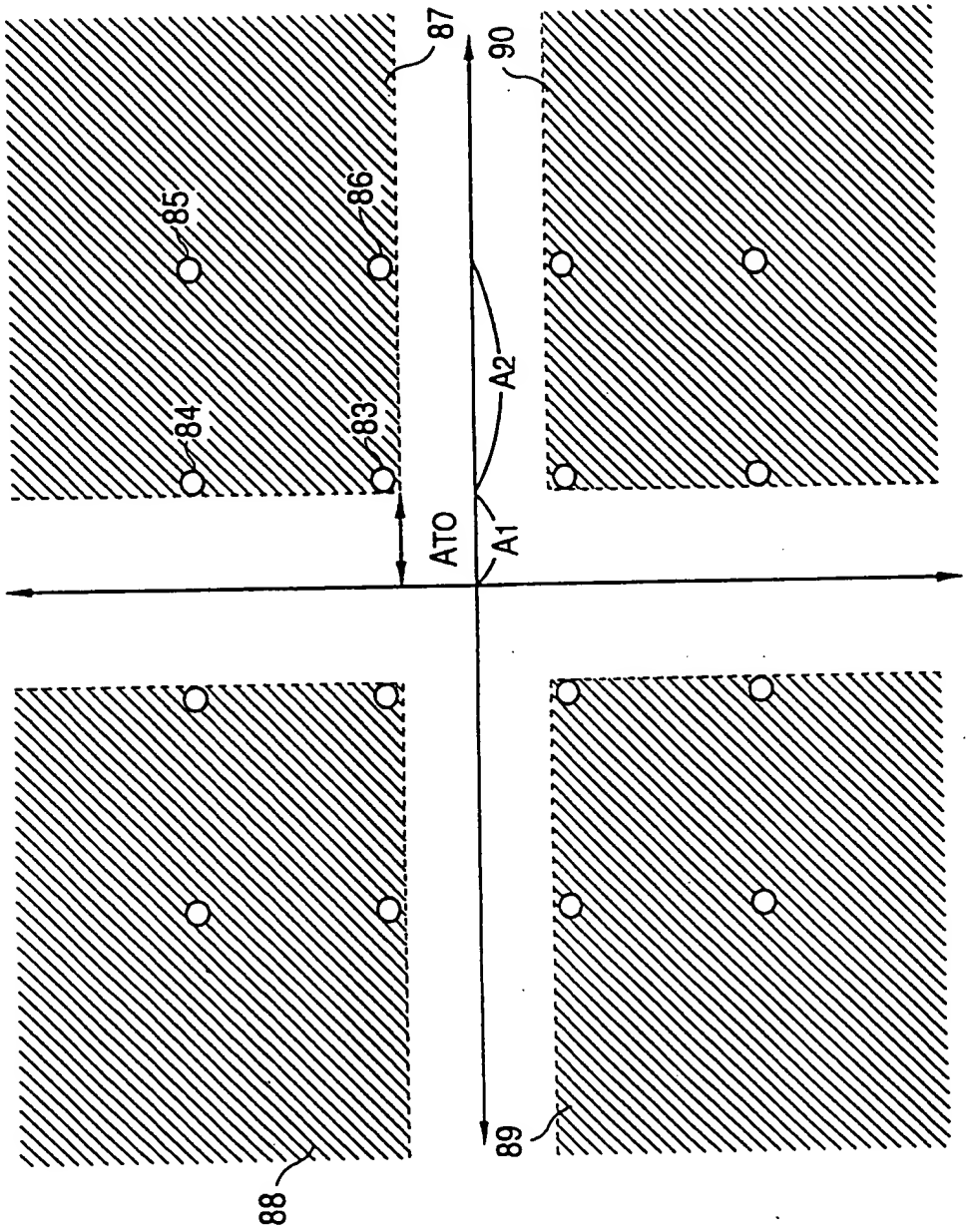
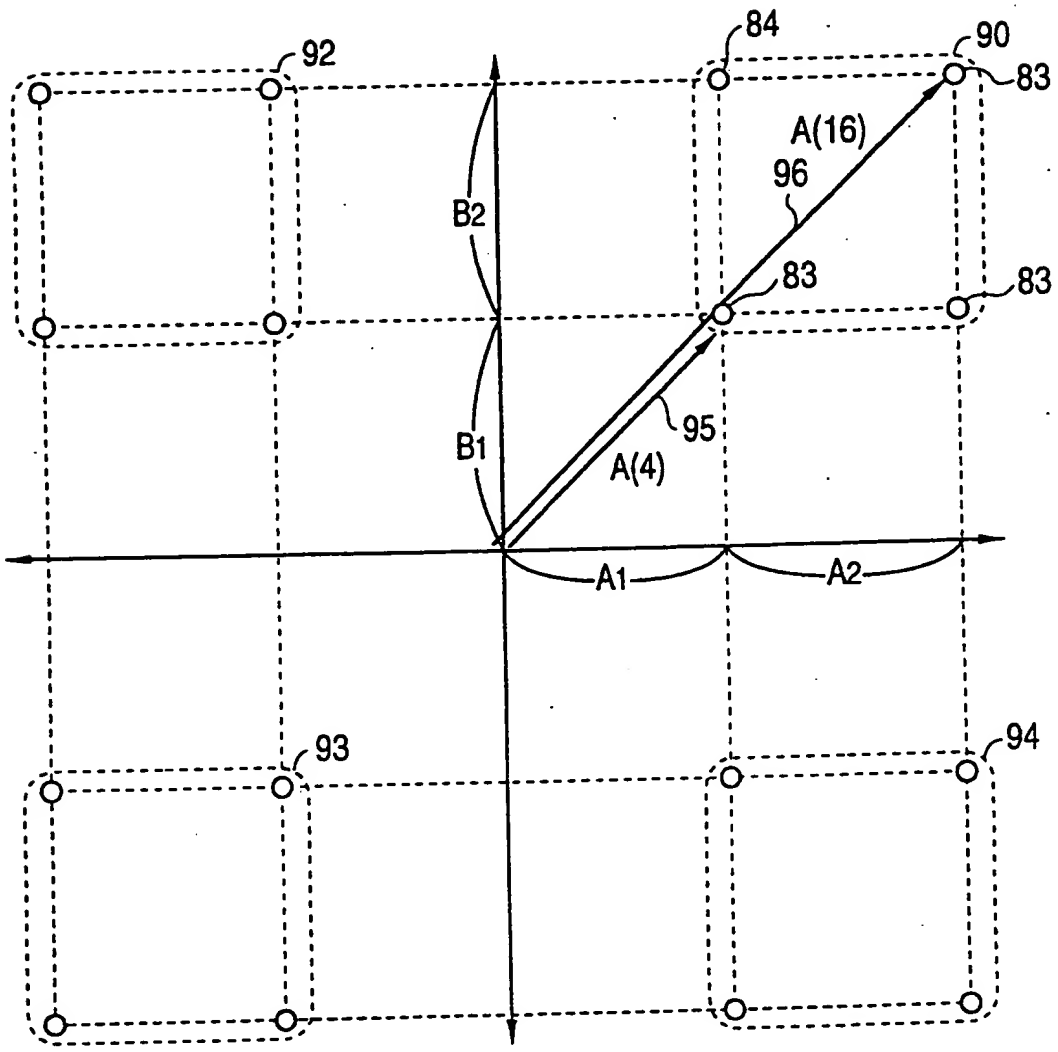


FIG. 9

FIG. 10



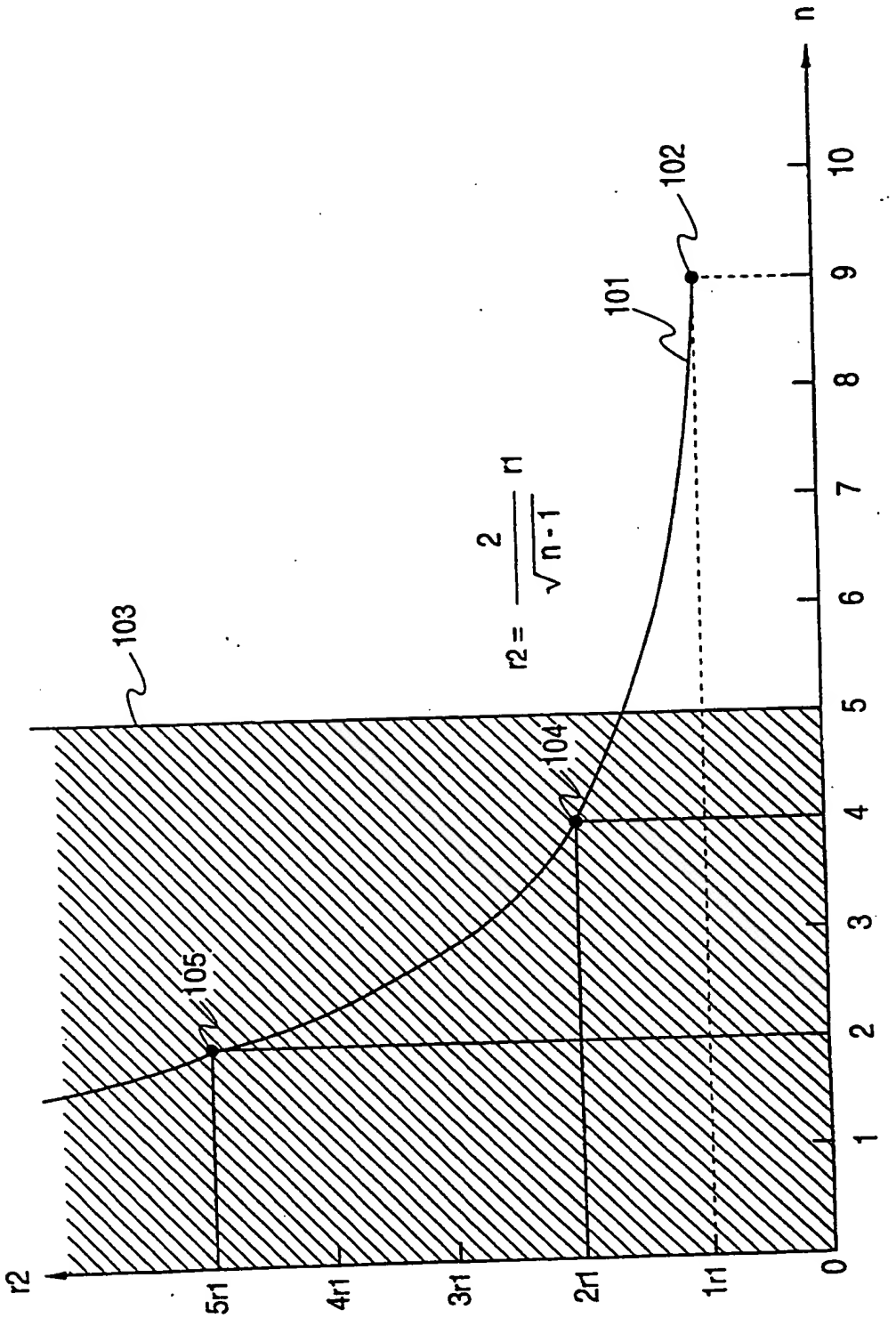
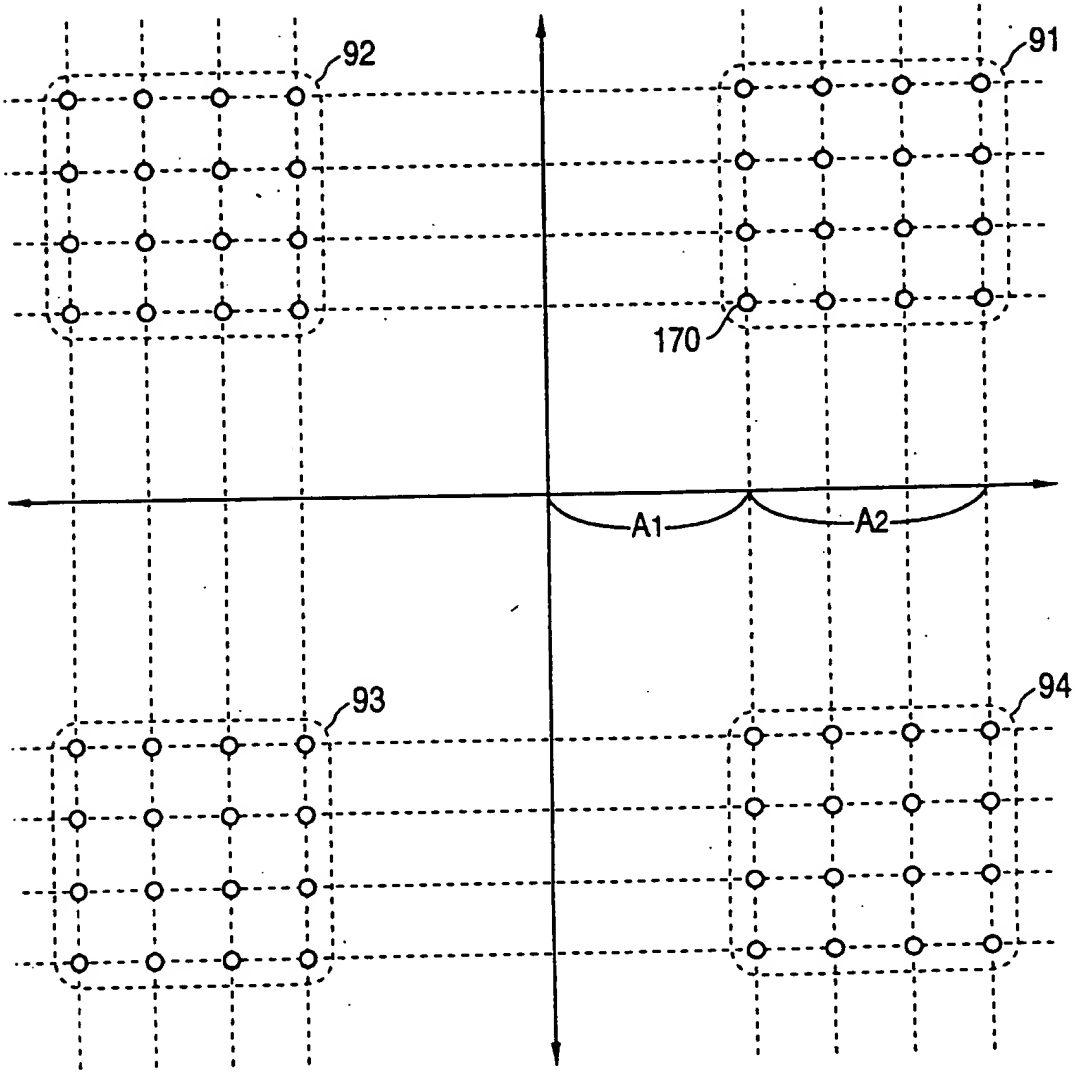

r2
n
0
1r1
2r1
3r1
4r1
5r1
1
2
3
4
5
6
7
8
9
10
101
102
103
104
105
r2 = 2/√n-1 r1

FIG. 11

FIG. 12



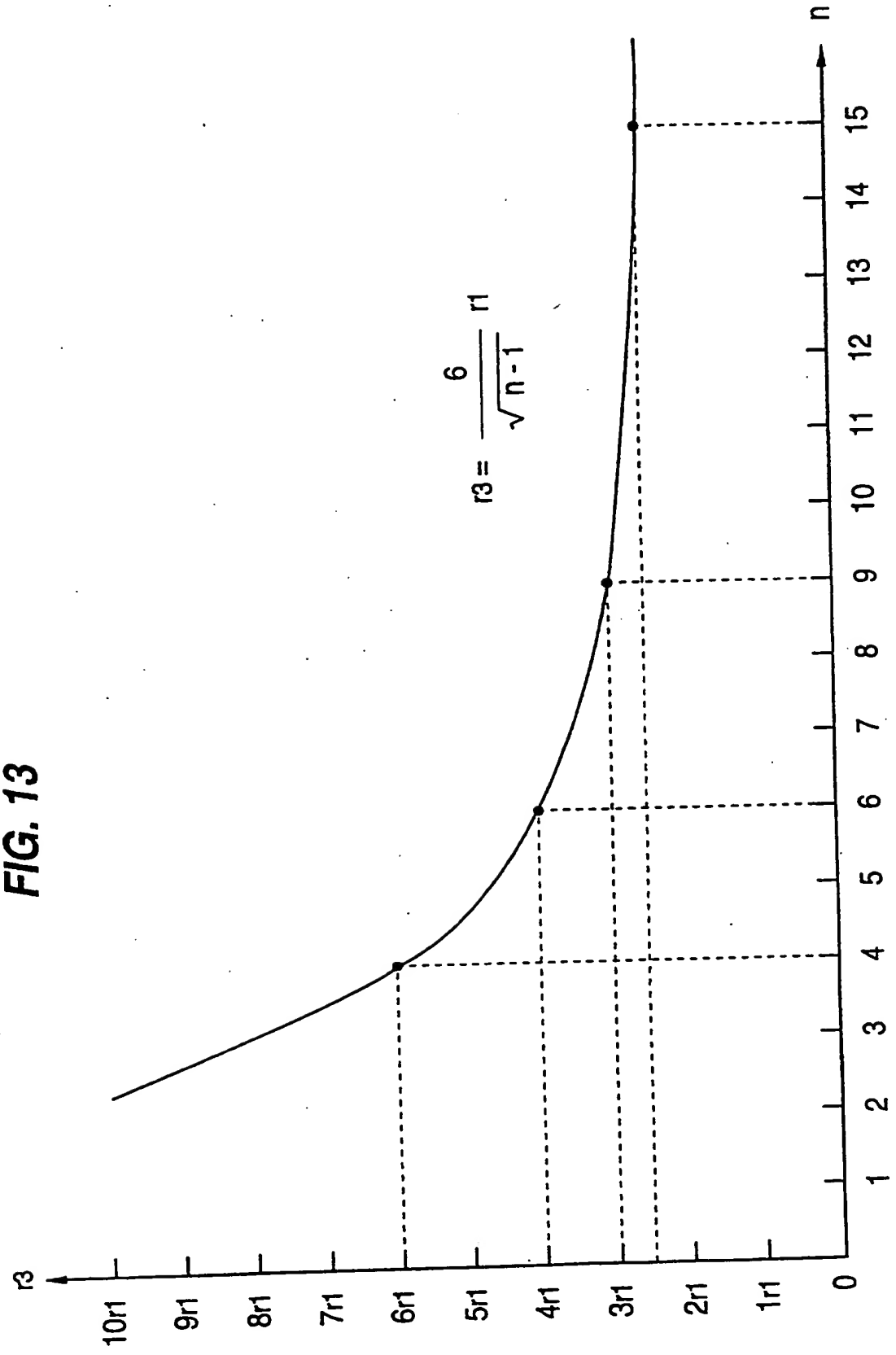

n
r3
$r3 = \frac{6}{\sqrt{n-1}} r1$
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
0
1r1
2r1
3r1
4r1
5r1
6r1
7r1
8r1
9r1
10r1

FIG. 13

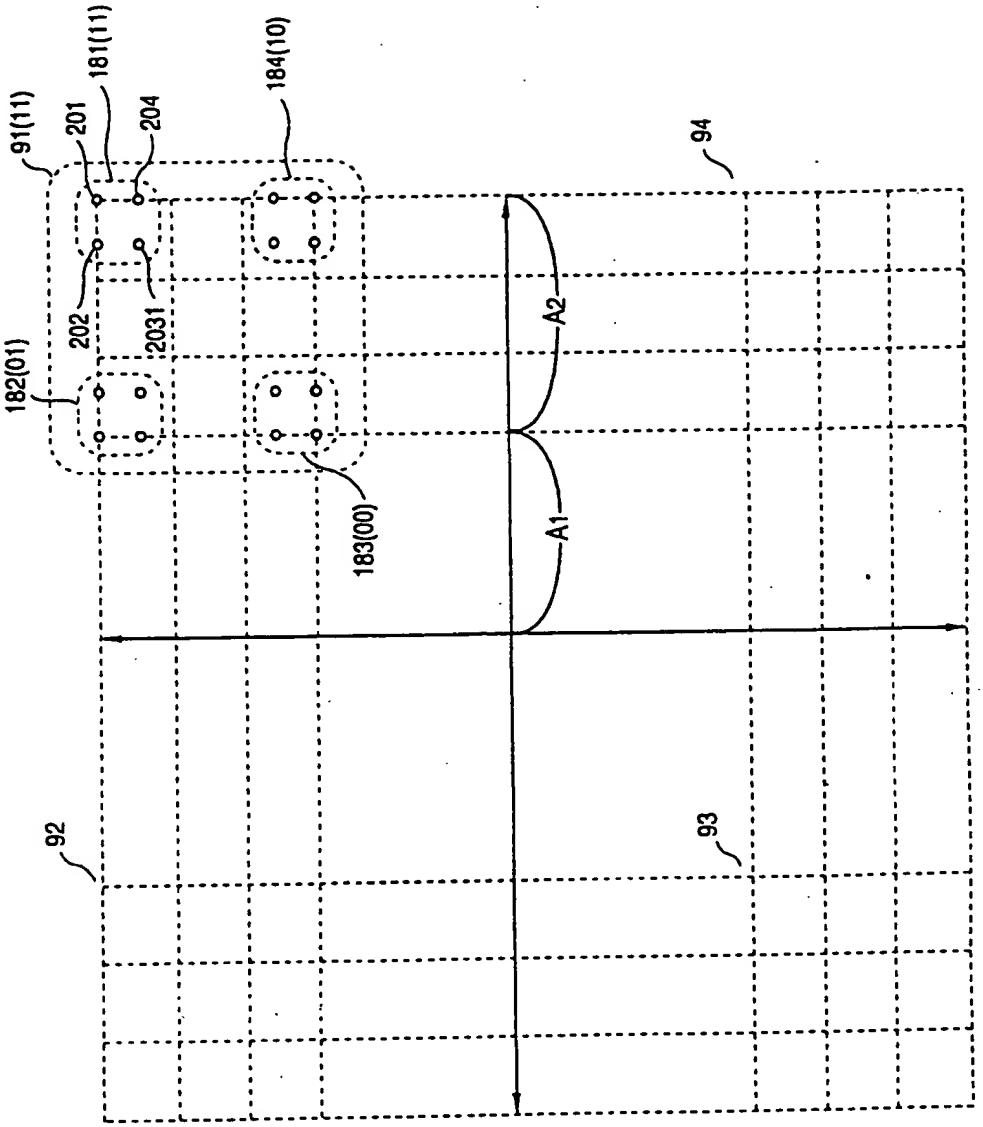


FIG. 14

FIG. 15

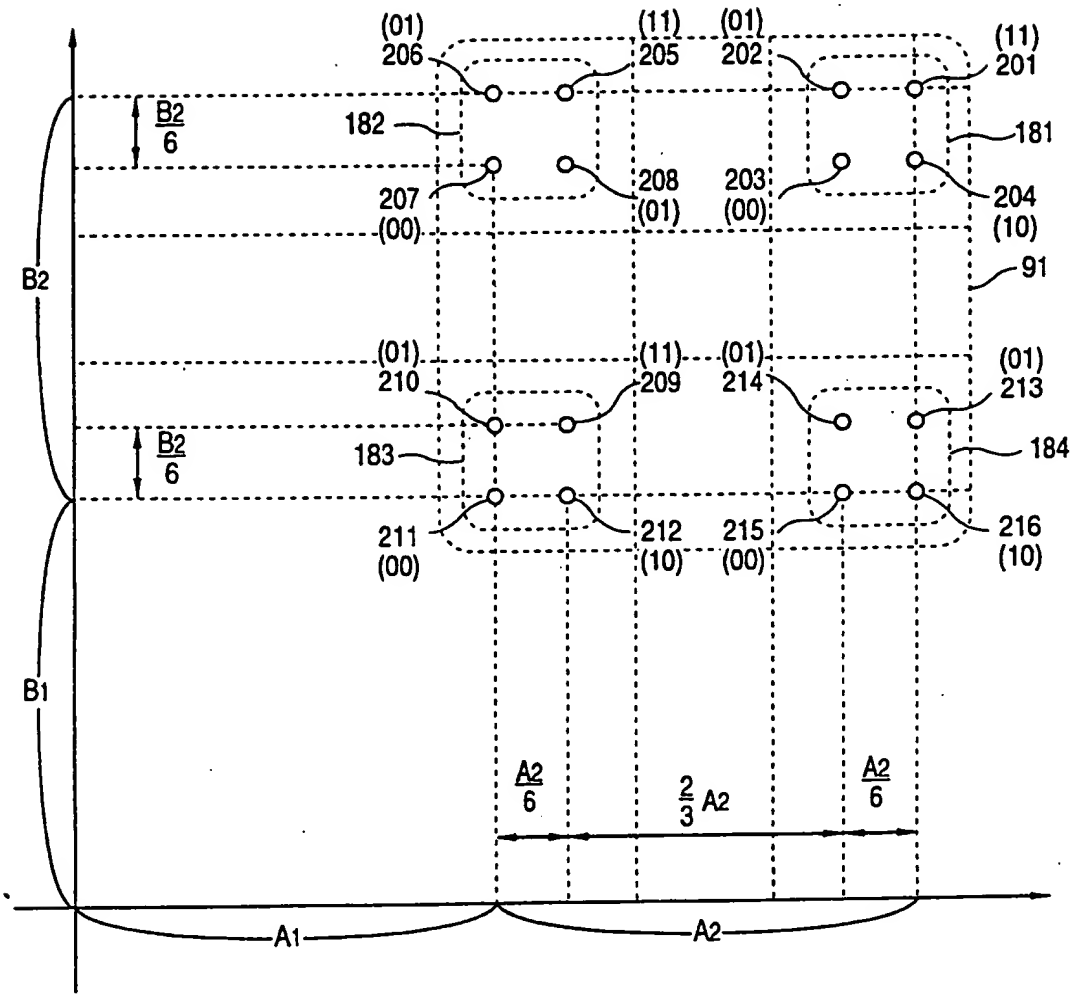
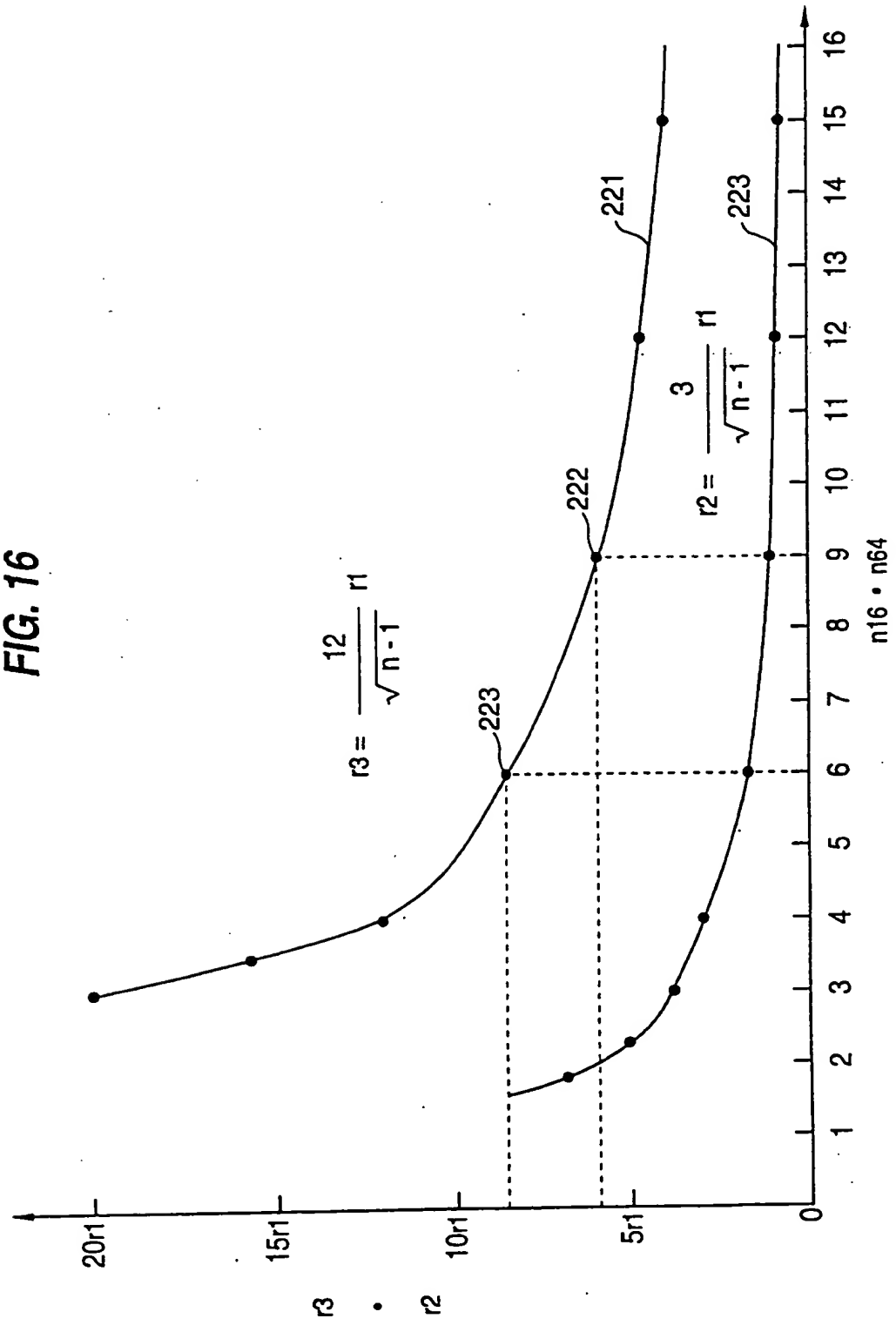

(01)
206
(11)
205
(01)
202
(11)
201
B2/6
182
181
207
(00)
208
(01)
203
(00)
204
(10)
91
B2
(01)
210
(11)
209
(01)
214
(01)
213
B2/6
183
184
211
(00)
212
(10)
215
(00)
216
(10)
B1
A2/6
2/3 A2
A2/6
A1
A2

FIG. 16


r3 = 12 / √(n-1) r1
r2 = 3 / √(n-1) r1
221
222
223
223
20r1
15r1
10r1
5r1
0
r3 • r2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
n16 • n64

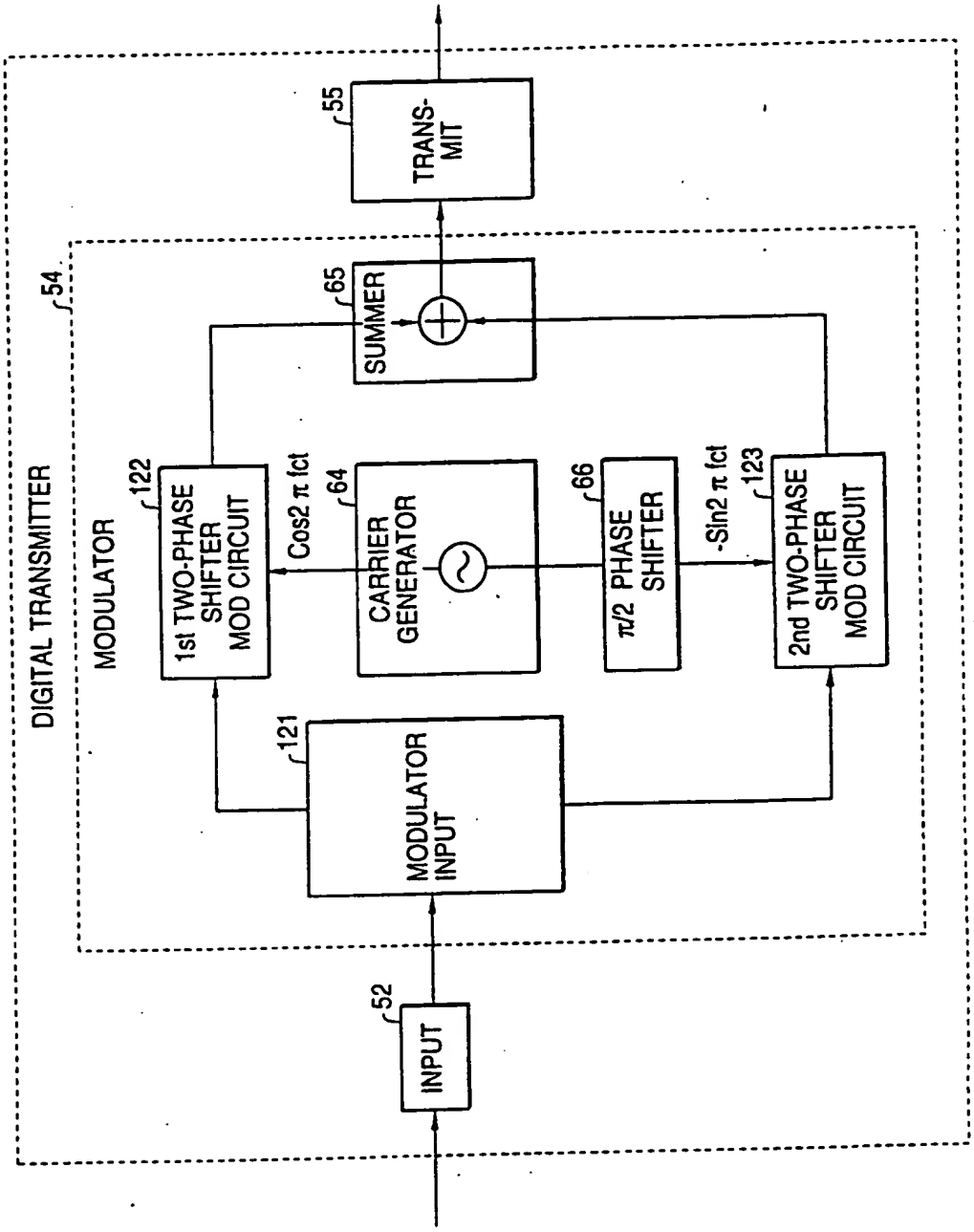
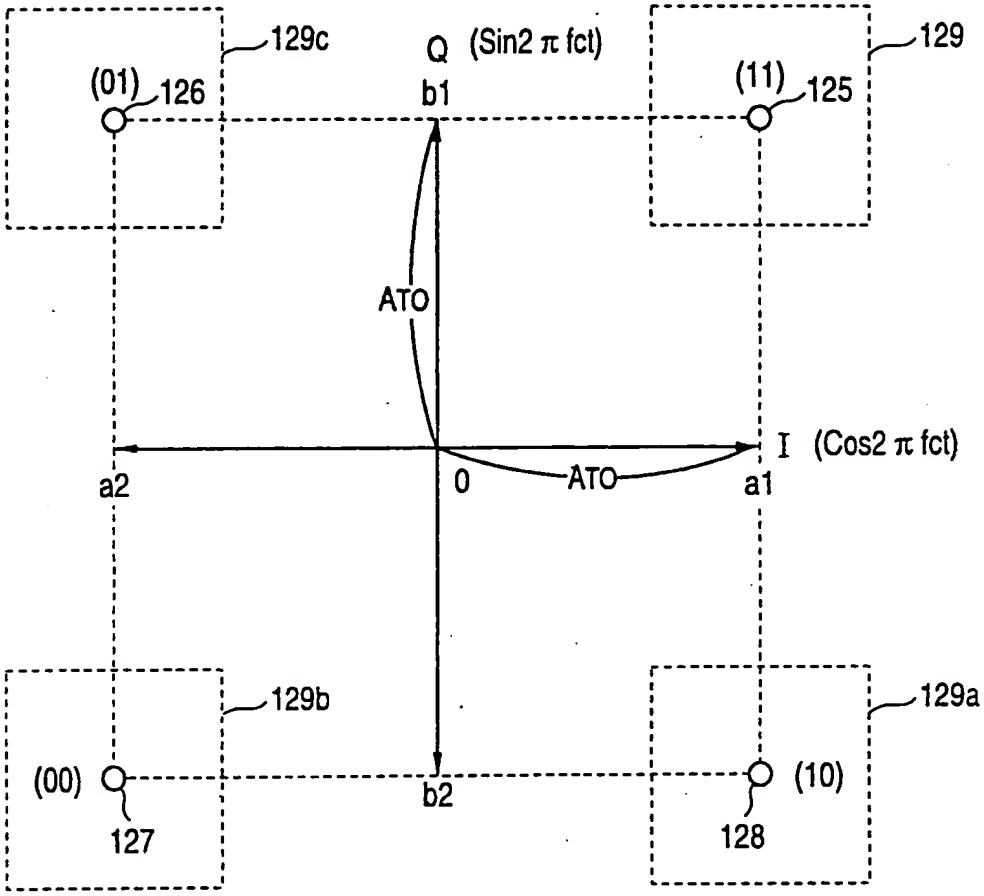

DIGITAL TRANSMITTER
54
MODULATOR
55
TRANS-MIT
65
SUMMER
122
1st TWO-PHASE SHIFTER MOD CIRCUIT
Cos2 π fct
64
CARRIER GENERATOR
66
π/2 PHASE SHIFTER
-Sin2 π fct
123
2nd TWO-PHASE SHIFTER MOD CIRCUIT
121
MODULATOR INPUT
52
INPUT

FIG. 17

FIG. 18


129c
Q (Sin2 π fct)
129
(01)
126
b1
(11)
125
ATO
I (Cos2 π fct)
a2
0
ATO
a1
129b
129a
(00)
(10)
b2
127
128

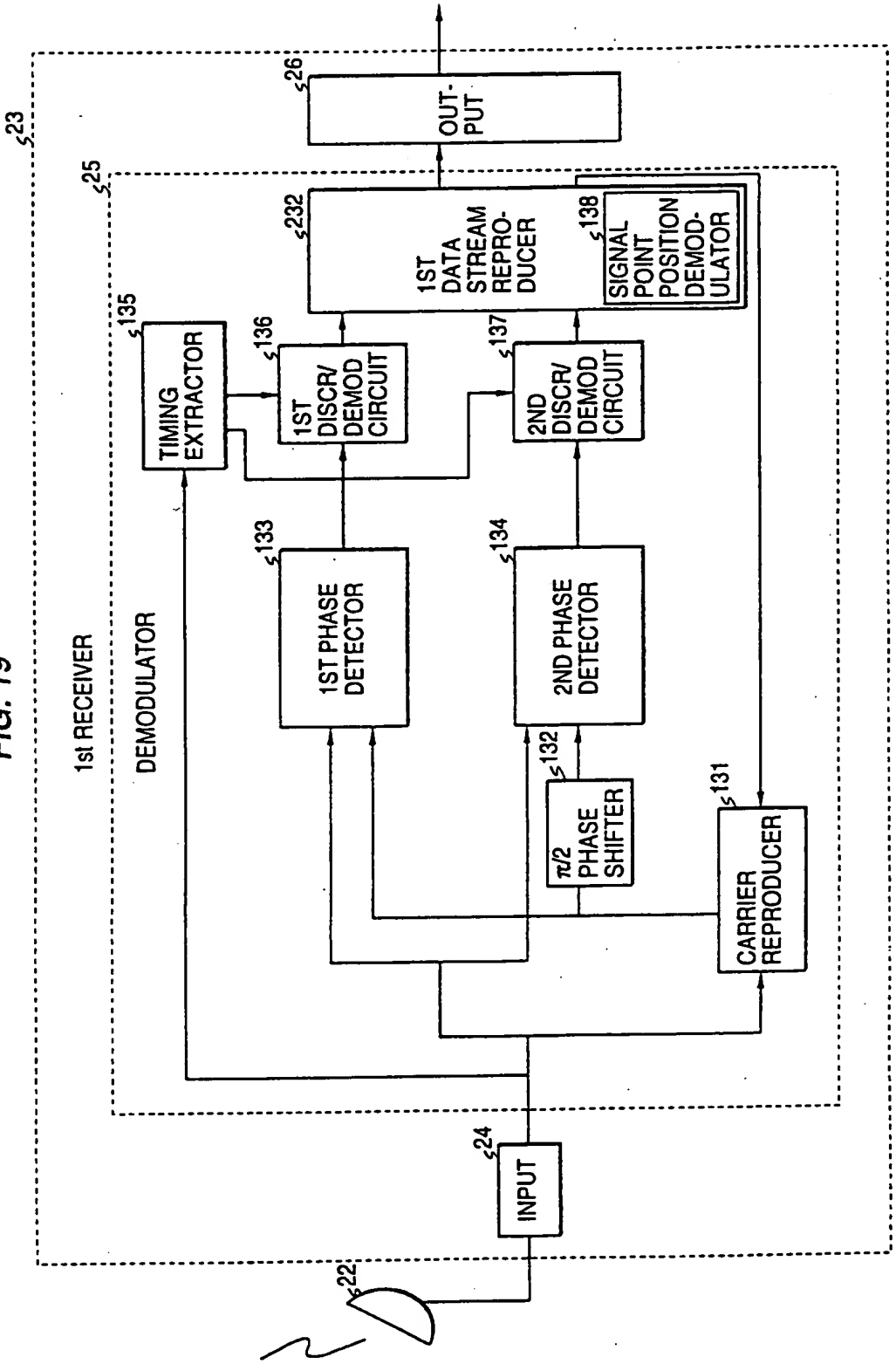
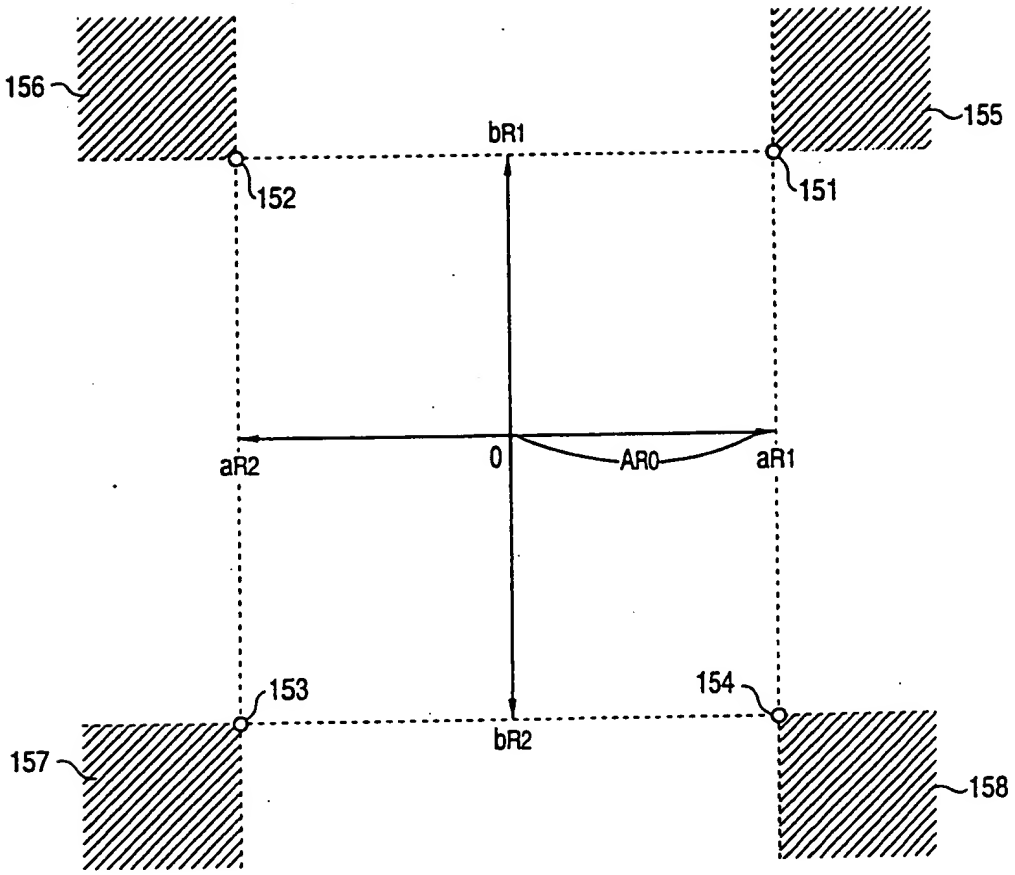

23
1st RECEIVER
DEMODULATOR
25
22
INPUT
24
OUT-PUT
26
1ST DATA STREAM REPRO-DUCER
232
SIGNAL POINT POSITION DEMOD-ULATOR
138
TIMING EXTRACTOR
135
1ST DISCR/ DEMOD CIRCUIT
136
2ND DISCR/ DEMOD CIRCUIT
137
1ST PHASE DETECTOR
133
2ND PHASE DETECTOR
134
π/2 PHASE SHIFTER
132
CARRIER REPRODUCER
131

FIG. 19

FIG. 20



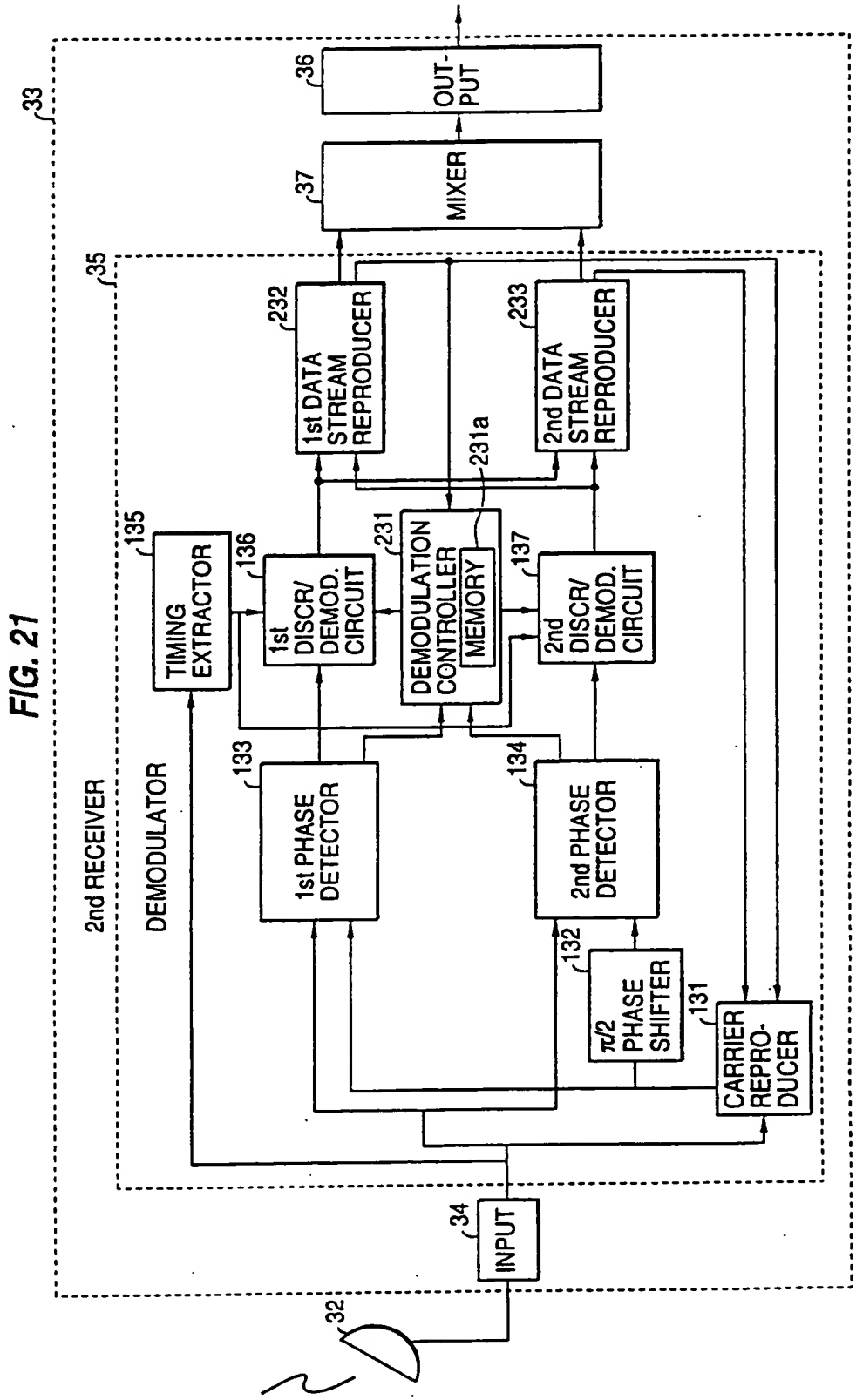
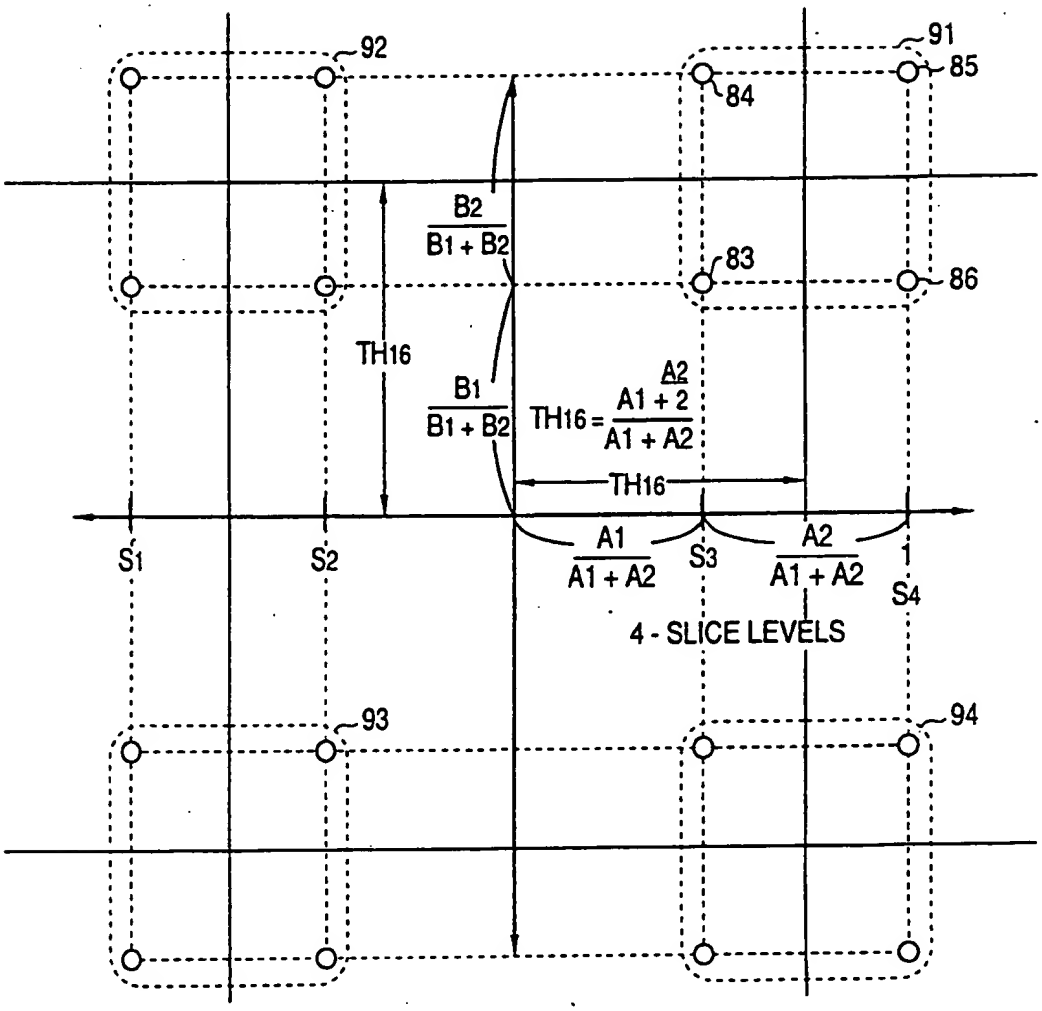

33
36
OUT-PUT
37
MIXER
35
232
1st DATA STREAM REPRODUCER
233
2nd DATA STREAM REPRODUCER
231a
135
TIMING EXTRACTOR
136
1st DISCR/ DEMOD. CIRCUIT
231
DEMODULATION CONTROLLER
MEMORY
137
2nd DISCR/ DEMOD. CIRCUIT
2nd RECEIVER
DEMODULATOR
133
1st PHASE DETECTOR
134
2nd PHASE DETECTOR
132
π/2 PHASE SHIFTER
131
CARRIER REPRO-DUCER
34
INPUT
32

FIG. 21

FIG. 22


92
91
85
84
B2
B1 + B2
83
86
TH16
B1
B1 + B2
TH16 = A2 / A1 + 2 / A1 + A2
TH16
S1
S2
A1
A1 + A2
S3
A2
A1 + A2
1
S4
4 - SLICE LEVELS
93
94

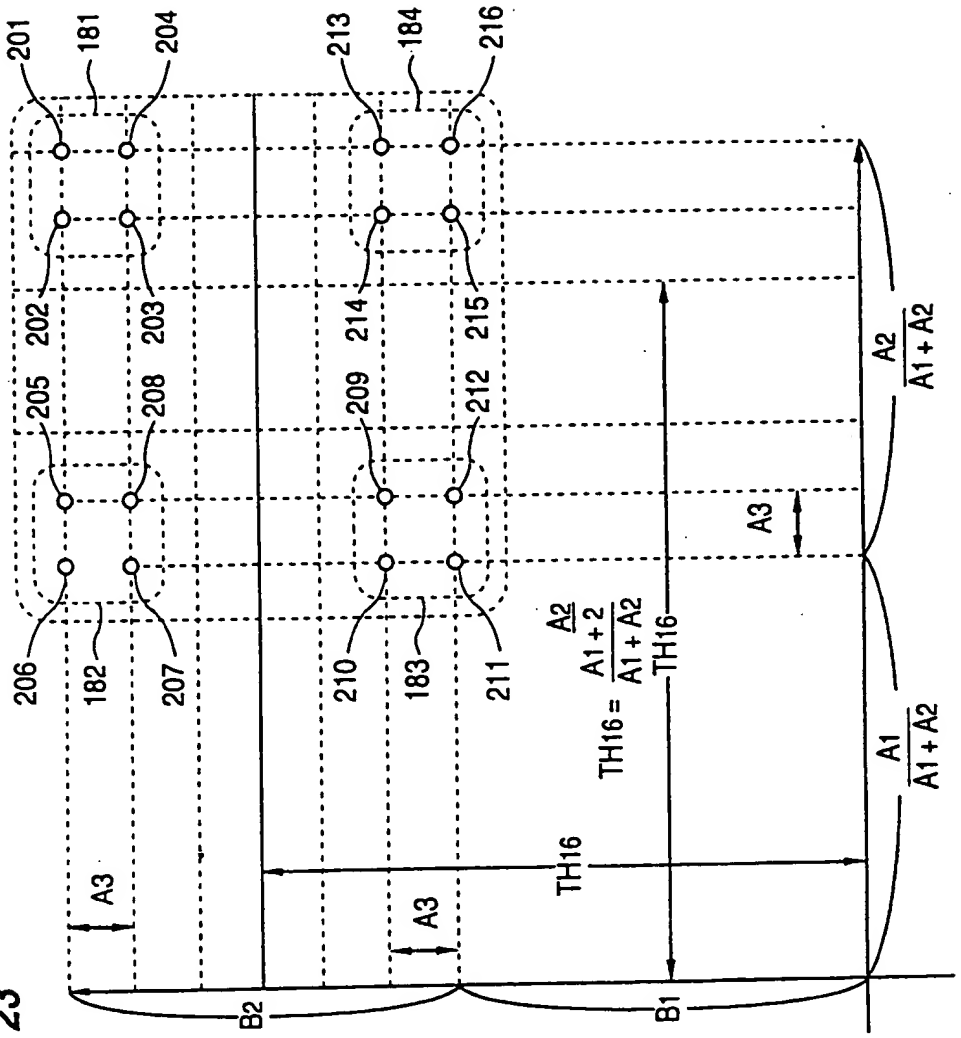

201
181
204
213
184
216
202
203
214
215
205
208
209
212
206
182
207
210
183
211
A3
A3
TH16
TH16 = A2 / A1 + A2 TH16
A2 / A1 + A2
A1 / A1 + A2
B2
B1

FIG. 23

FIG. 24

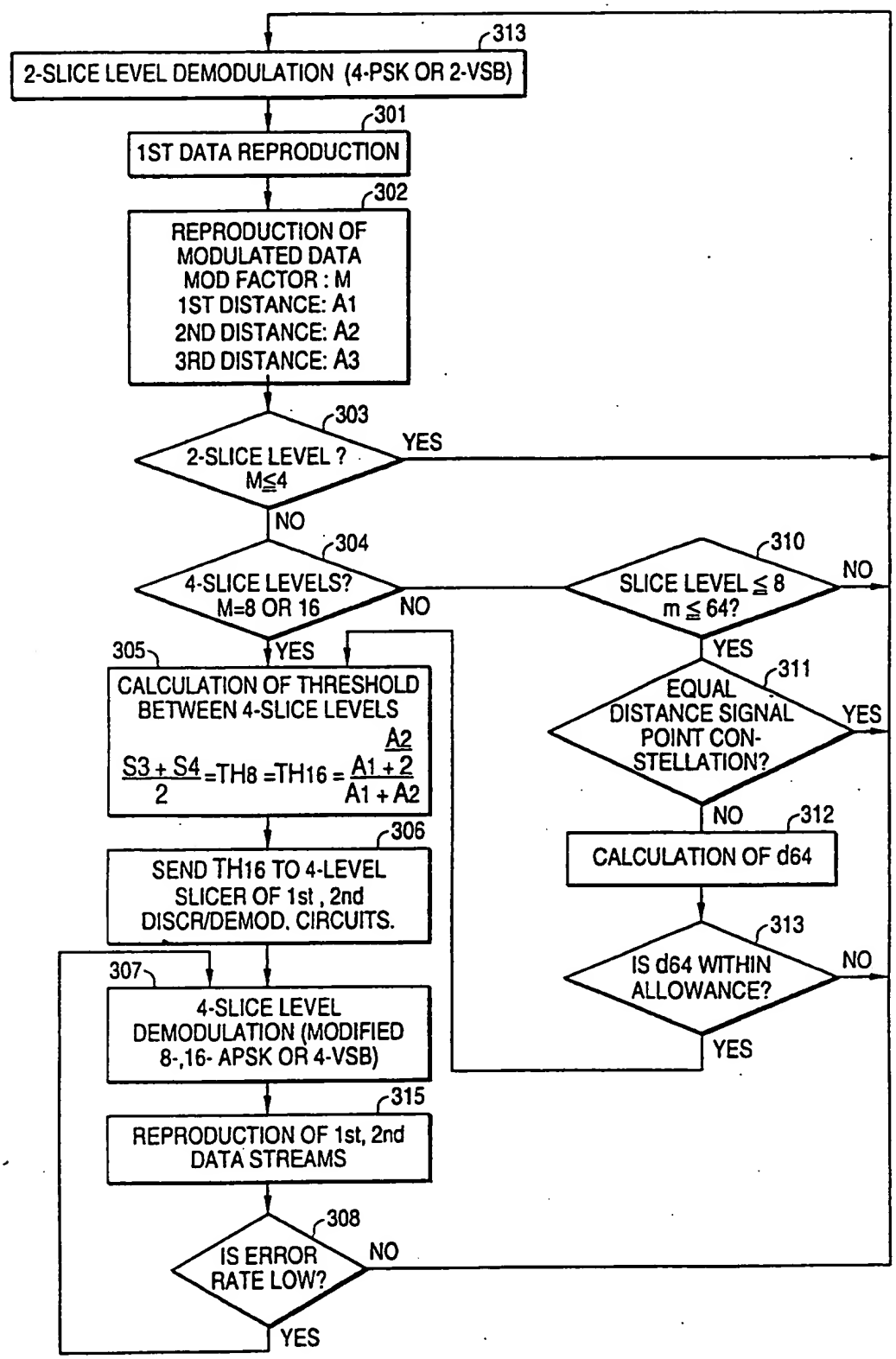

313
2-SLICE LEVEL DEMODULATION (4-PSK OR 2-VSB)
301
1ST DATA REPRODUCTION
302
REPRODUCTION OF MODULATED DATA
MOD FACTOR : M
1ST DISTANCE: A1
2ND DISTANCE: A2
3RD DISTANCE: A3
303
2-SLICE LEVEL ? M≦4
YES
NO
304
4-SLICE LEVELS? M=8 OR 16
NO
YES
310
SLICE LEVEL ≦ 8 m ≦ 64?
NO
YES
311
EQUAL DISTANCE SIGNAL POINT CONSTELLATION?
YES
NO
312
CALCULATION OF d64
313
IS d64 WITHIN ALLOWANCE?
NO
YES
305
CALCULATION OF THRESHOLD BETWEEN 4-SLICE LEVELS
(S3 + S4)/2 = TH8 = TH16 = (A1 + A2/2)/(A1 + A2)
306
SEND TH16 TO 4-LEVEL SLICER OF 1st, 2nd DISCR/DEMOD. CIRCUITS.
307
4-SLICE LEVEL DEMODULATION (MODIFIED 8-,16- APSK OR 4-VSB)
315
REPRODUCTION OF 1st, 2nd DATA STREAMS
308
IS ERROR RATE LOW?
NO
YES

FIG. 25(a)

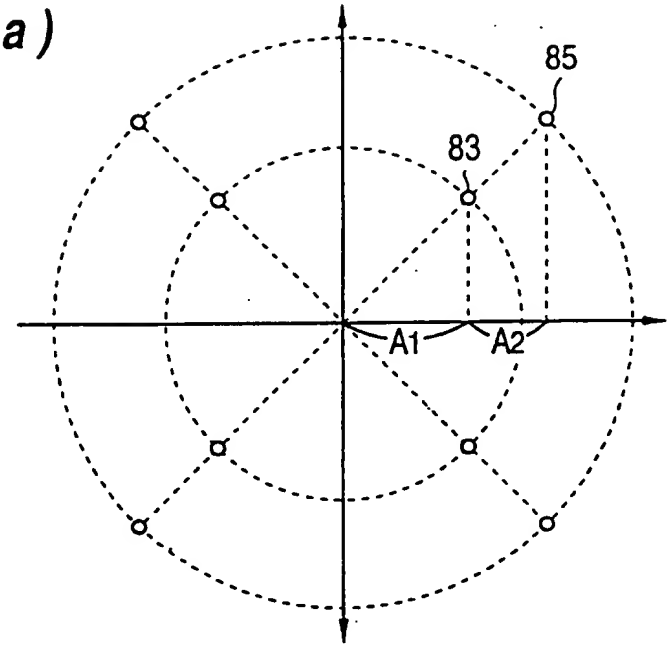


FIG. 25(b)

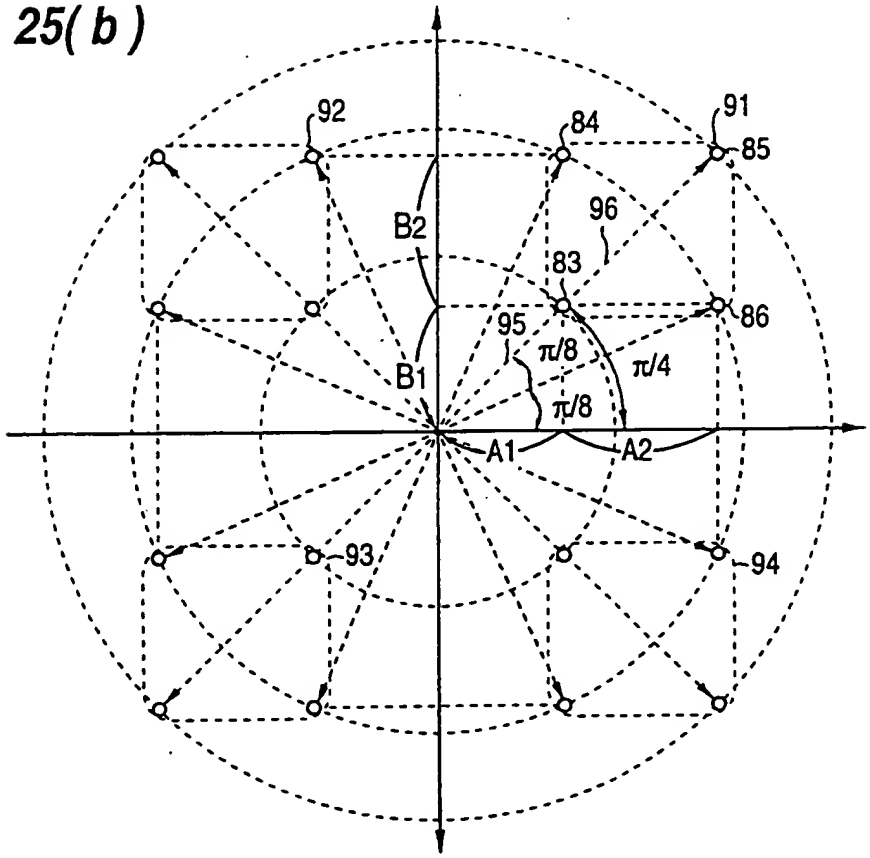
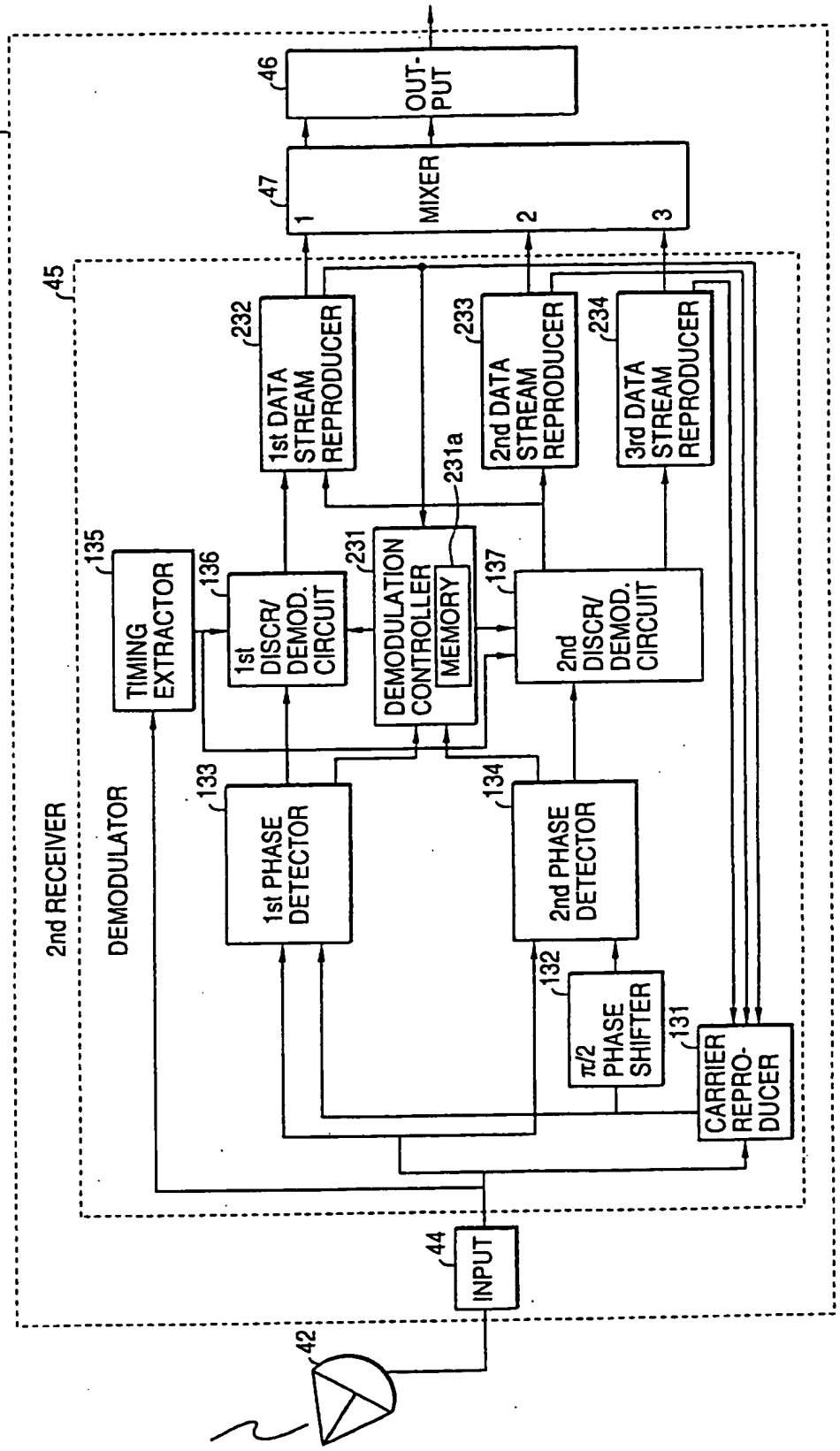


FIG. 26


2nd RECEIVER
43
DEMODULATOR
45
OUT-PUT
46
MIXER
47
1
2
3
1st DATA STREAM REPRODUCER
232
2nd DATA STREAM REPRODUCER
233
3rd DATA STREAM REPRODUCER
234
231a
TIMING EXTRACTOR
135
1st DISCR/ DEMOD. CIRCUIT
136
DEMODULATION CONTROLLER
231
MEMORY
2nd DISCR/ DEMOD. CIRCUIT
137
1st PHASE DETECTOR
133
2nd PHASE DETECTOR
134
π/2 PHASE SHIFTER
132
CARRIER REPRO-DUCER
131
INPUT
44
42

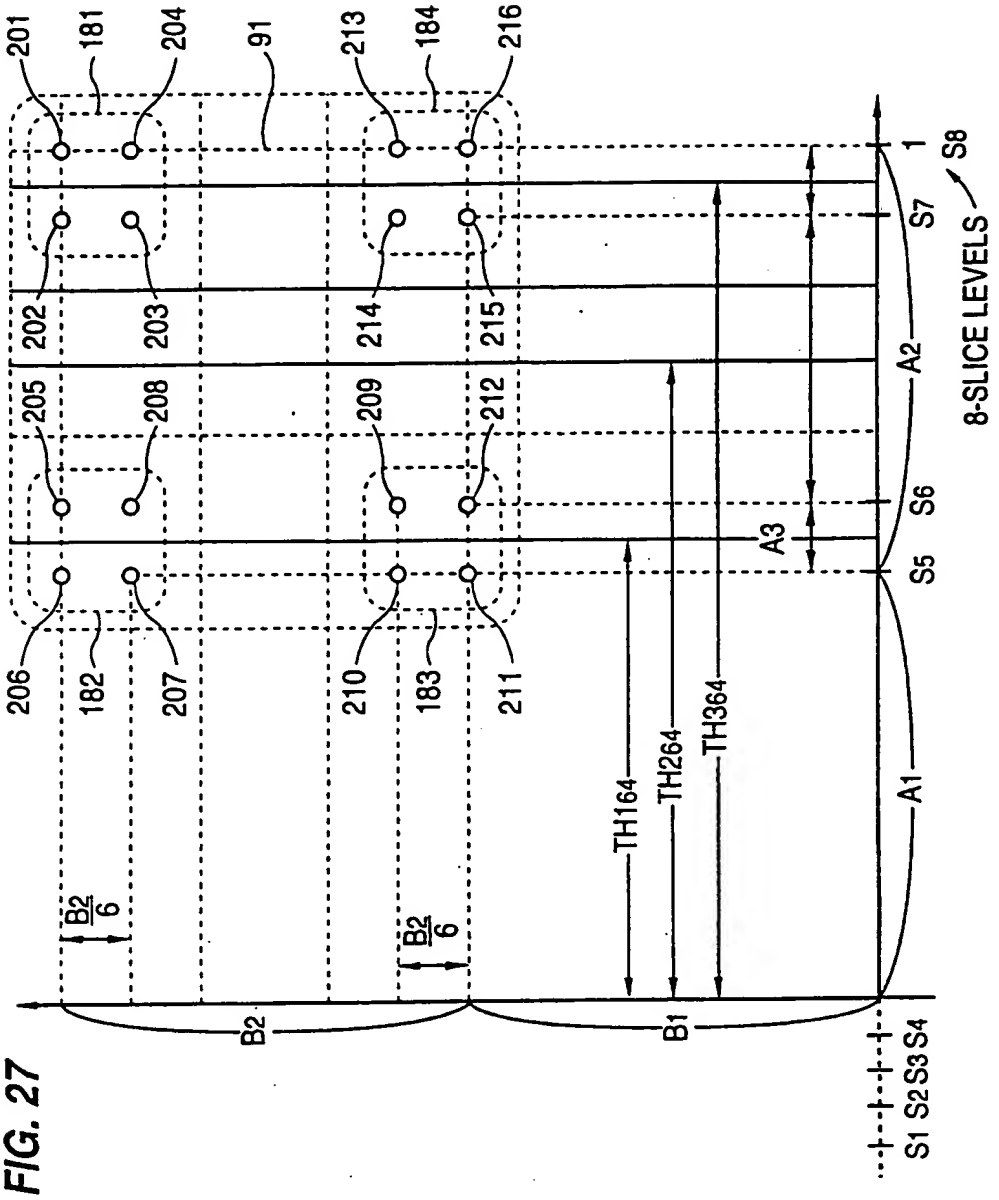
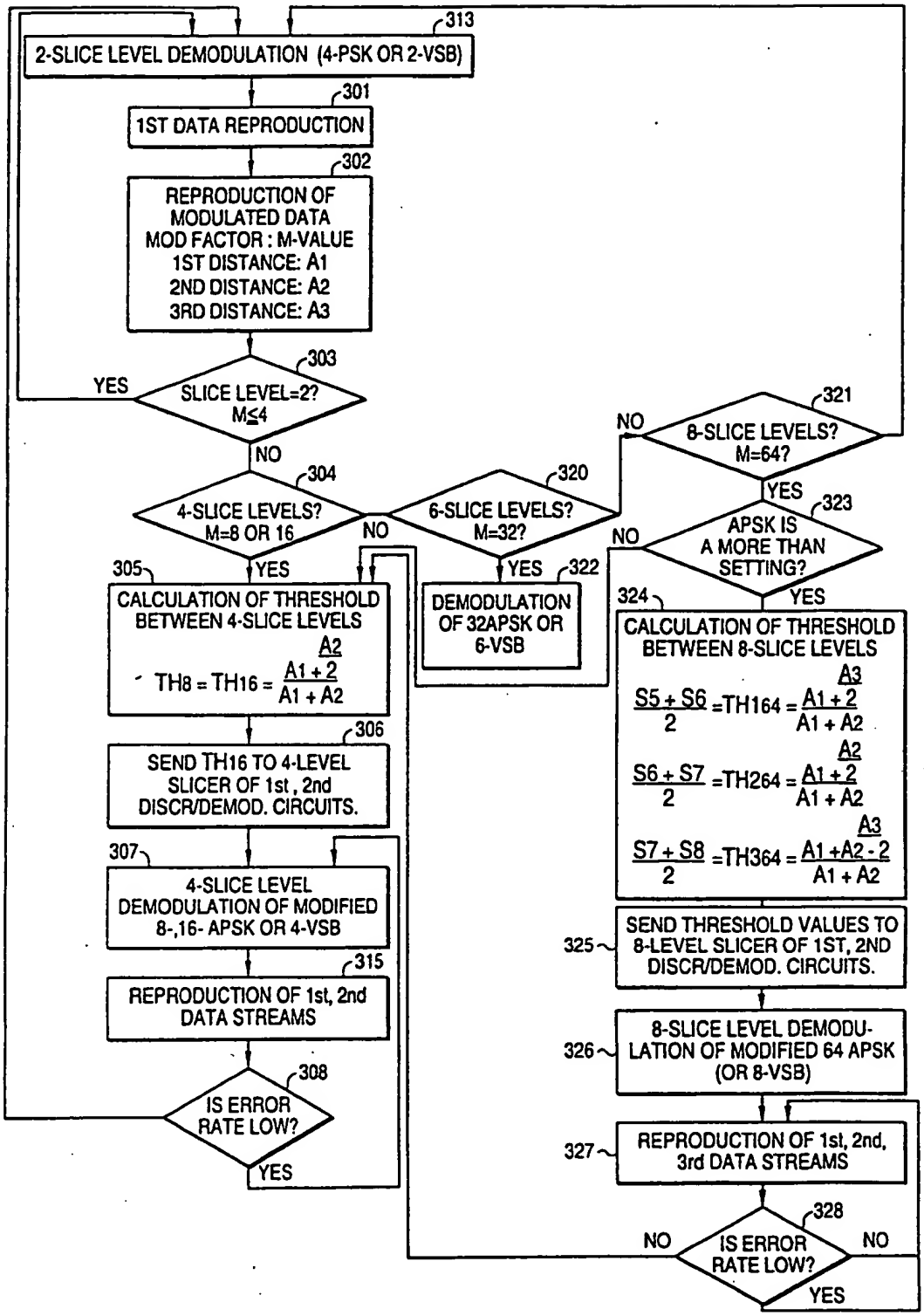

201
181
204
91
213
184
216
202
203
214
215
205
208
209
212
206
182
207
210
183
211
B2/6
B2/6
B2
B1
TH164
TH264
TH364
A1
A2
A3
S1 S2 S3 S4
S5
S6
S7
S8
1
8-SLICE LEVELS

FIG. 27

FIG. 28


313
2-SLICE LEVEL DEMODULATION (4-PSK OR 2-VSB)
301
1ST DATA REPRODUCTION
302
REPRODUCTION OF MODULATED DATA
MOD FACTOR : M-VALUE
1ST DISTANCE: A1
2ND DISTANCE: A2
3RD DISTANCE: A3
303
YES
SLICE LEVEL=2? M≤4
NO
304
4-SLICE LEVELS? M=8 OR 16
320
6-SLICE LEVELS? M=32?
321
8-SLICE LEVELS? M=64?
NO
YES
323
APSK IS A MORE THAN SETTING?
NO
YES
305
YES
CALCULATION OF THRESHOLD BETWEEN 4-SLICE LEVELS
TH8 = TH16 = (A1 + 2A2) / (A1 + A2)
NO
YES
322
DEMODULATION OF 32APSK OR 6-VSB
324
CALCULATION OF THRESHOLD BETWEEN 8-SLICE LEVELS
(S5 + S6)/2 = TH164 = (A1 + 2A3) / (A1 + A2)
(S6 + S7)/2 = TH264 = (A1 + 2A2) / (A1 + A2)
(S7 + S8)/2 = TH364 = (A1 + A2 + 2A3) / (A1 + A2)
306
SEND TH16 TO 4-LEVEL SLICER OF 1st, 2nd DISCR/DEMOD. CIRCUITS.
307
4-SLICE LEVEL DEMODULATION OF MODIFIED 8-,16- APSK OR 4-VSB
315
REPRODUCTION OF 1st, 2nd DATA STREAMS
308
IS ERROR RATE LOW?
YES
325
SEND THRESHOLD VALUES TO 8-LEVEL SLICER OF 1ST, 2ND DISCR/DEMOD. CIRCUITS.
326
8-SLICE LEVEL DEMODULATION OF MODIFIED 64 APSK (OR 8-VSB)
327
REPRODUCTION OF 1st, 2nd, 3rd DATA STREAMS
328
NO
IS ERROR RATE LOW?
NO
YES

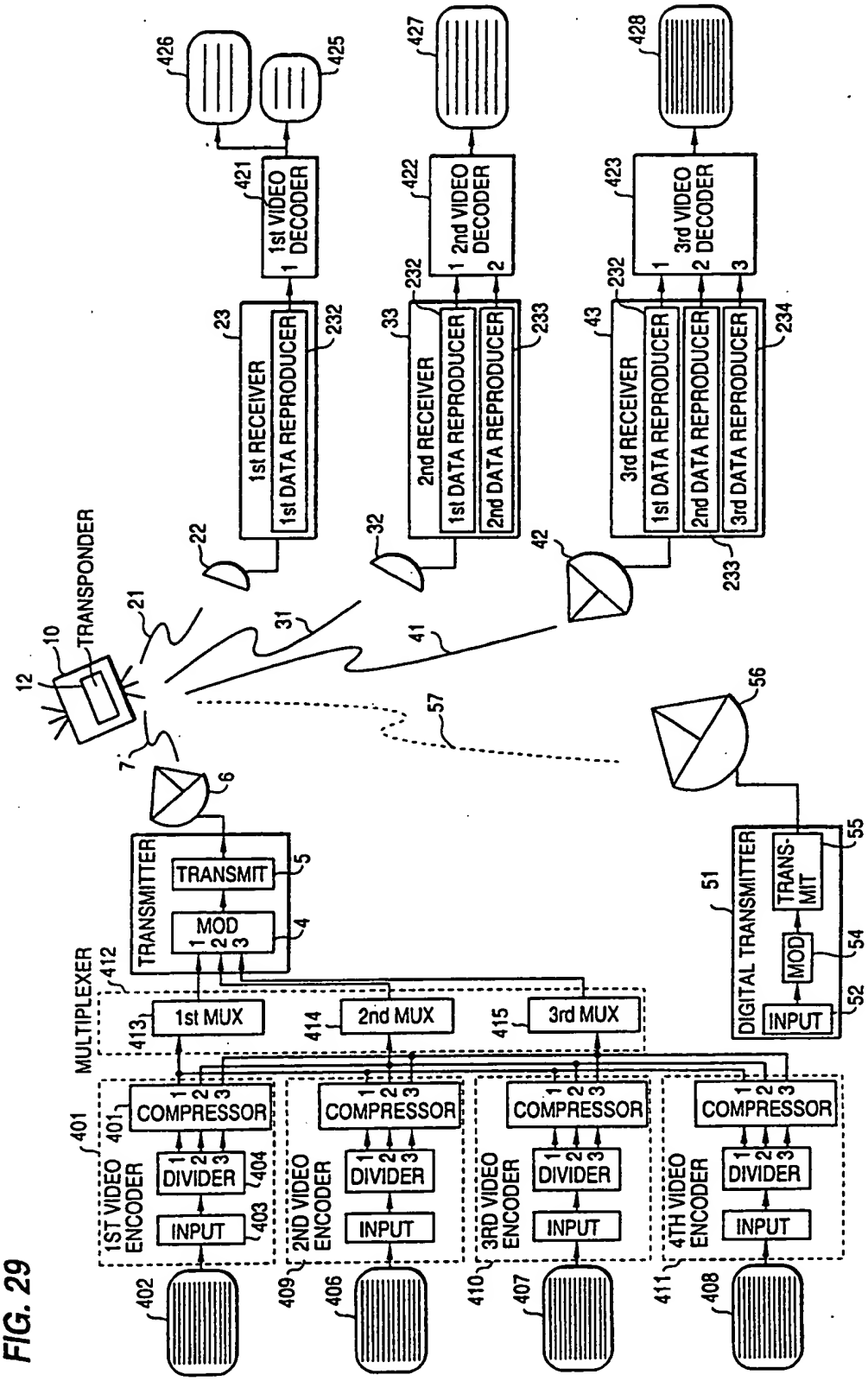

426
425
427
428
421 1st VIDEO DECODER
422 2nd VIDEO DECODER
423 3rd VIDEO DECODER
23
232
33
233
43
234
1st RECEIVER
1st DATA REPRODUCER
2nd RECEIVER
2nd DATA REPRODUCER
3rd RECEIVER
3rd DATA REPRODUCER
22
32
42
TRANSPONDER
10
12
21
31
41
57
56
7
6
TRANSMITTER
TRANSMIT
MOD
5
4
MULTIPLEXER
412
1st MUX
2nd MUX
3rd MUX
413
414
415
DIGITAL TRANSMITTER
TRANS-MIT
55
51
54
52
INPUT
401
COMPRESSOR
DIVIDER
INPUT
404
403
1ST VIDEO ENCODER
2ND VIDEO ENCODER
3RD VIDEO ENCODER
4TH VIDEO ENCODER
402
409
406
410
407
411
408

FIG. 29

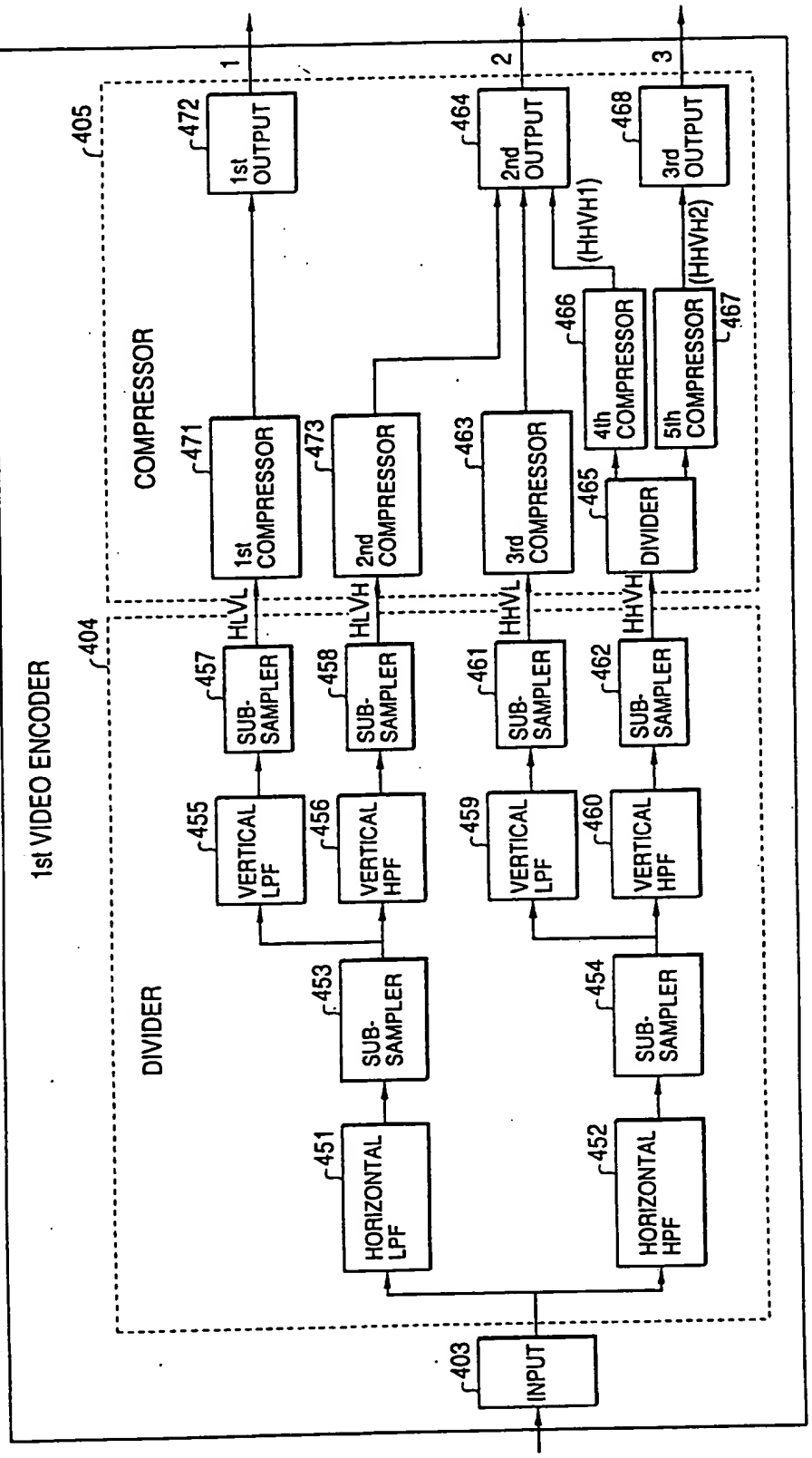

401
1st VIDEO ENCODER
405
COMPRESSOR
404
DIVIDER
403
INPUT
451
HORIZONTAL LPF
452
HORIZONTAL HPF
453
SUB-SAMPLER
454
SUB-SAMPLER
455
VERTICAL LPF
456
VERTICAL HPF
457
SUB-SAMPLER
458
SUB-SAMPLER
459
VERTICAL LPF
460
VERTICAL HPF
461
SUB-SAMPLER
462
SUB-SAMPLER
463
3rd COMPRESSOR
464
2nd OUTPUT
465
DIVIDER
466
4th COMPRESSOR
467
5th COMPRESSOR
468
3rd OUTPUT
471
1st COMPRESSOR
472
1st OUTPUT
473
2nd COMPRESSOR
HLVL
HLVH
HHVL
HHVH
(HHVH1)
(HHVH2)
1
2
3

FIG. 30

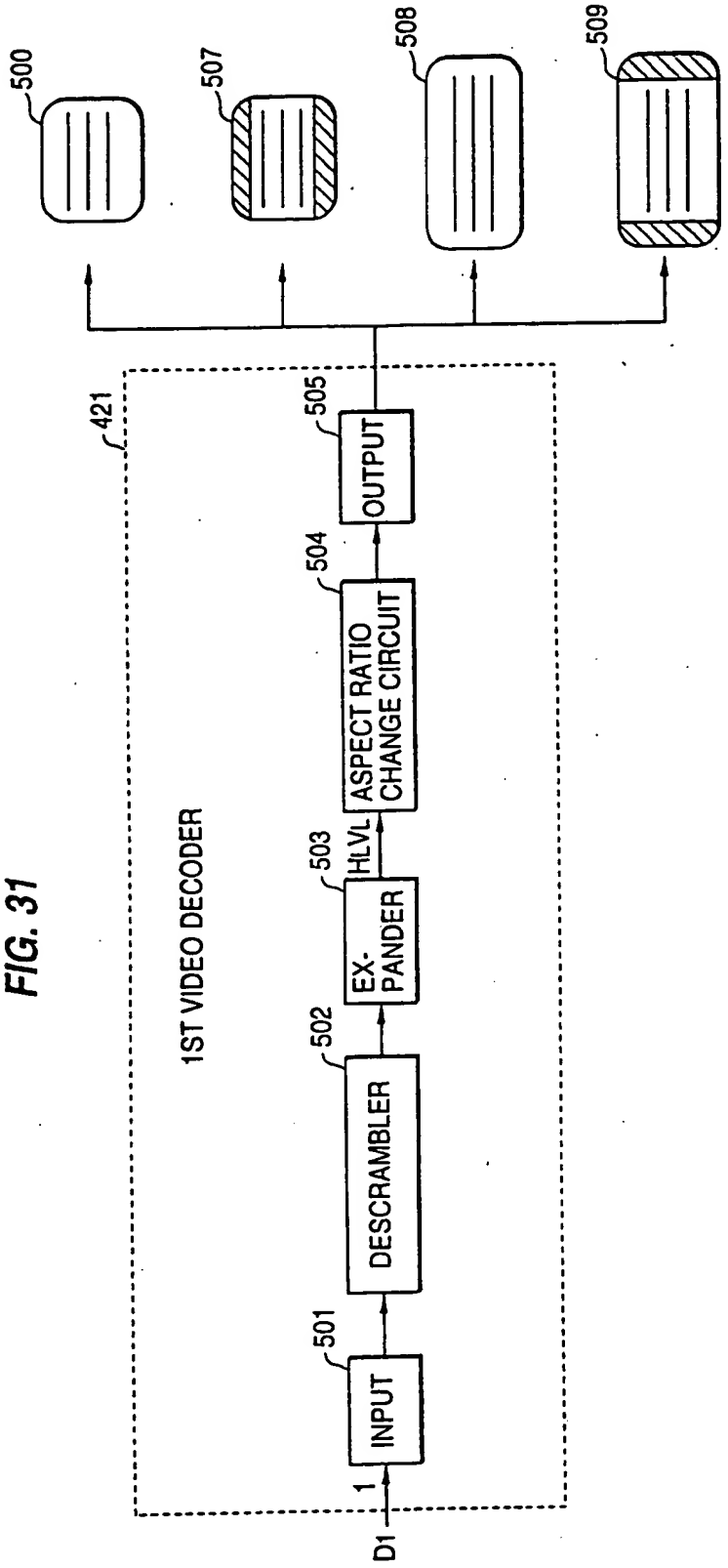

500
507
508
509
421
505
OUTPUT
504
ASPECT RATIO CHANGE CIRCUIT
503
HLVL
EX-PANDER
502
DESCRAMBLER
501
INPUT
1
D1
1ST VIDEO DECODER

FIG. 31

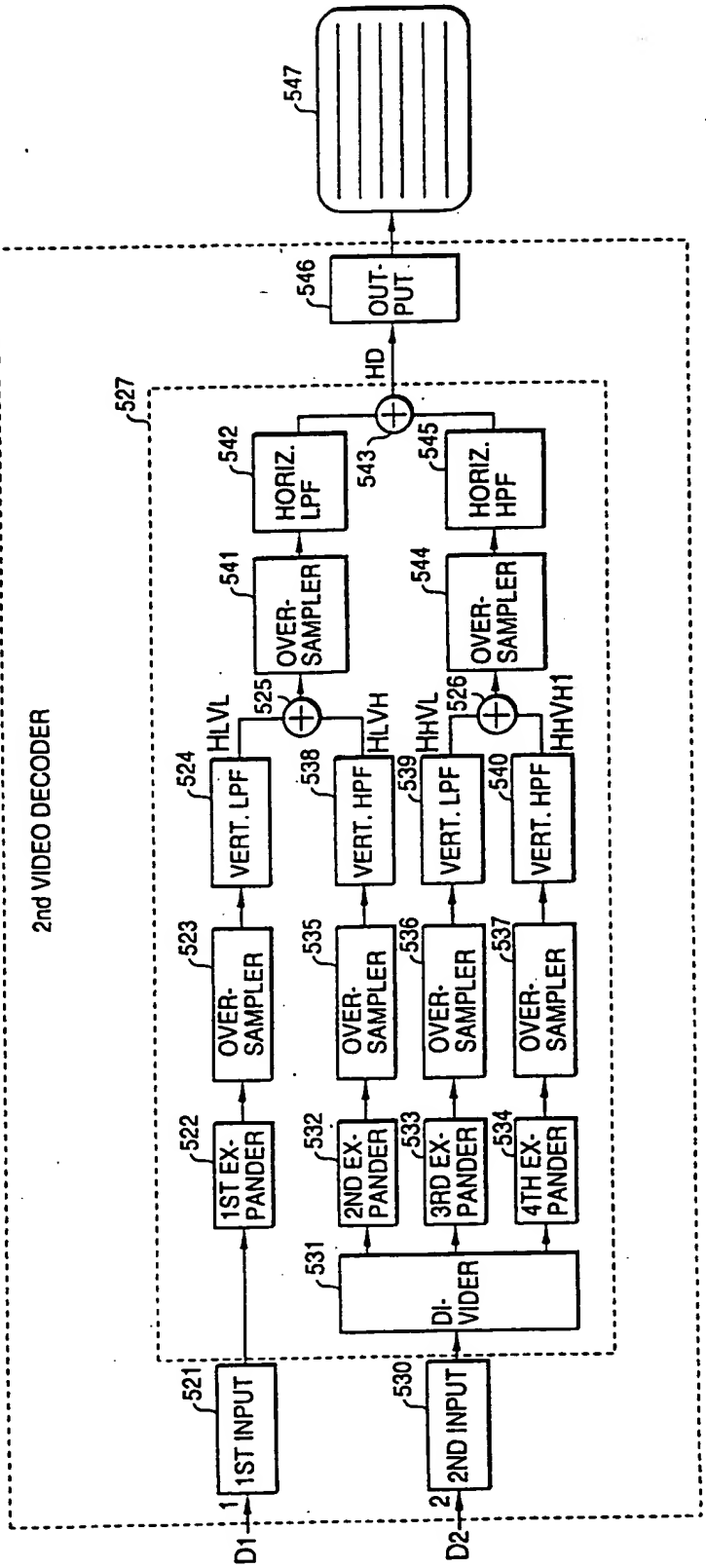

422
2nd VIDEO DECODER
547
546
OUT-PUT
HD
527
542
HORIZ. LPF
543
545
HORIZ. HPF
541
OVER-SAMPLER
544
OVER-SAMPLER
525
526
HLVL
HLVH
HHVL
HHVH1
524
VERT. LPF
538
VERT. HPF
539
VERT. LPF
540
VERT. HPF
523
OVER-SAMPLER
535
OVER-SAMPLER
536
OVER-SAMPLER
537
OVER-SAMPLER
522
1ST EX-PANDER
532
2ND EX-PANDER
533
3RD EX-PANDER
534
4TH EX-PANDER
531
DI-VIDER
521
1ST INPUT
530
2ND INPUT
1
2
D1
D2

FIG. 32

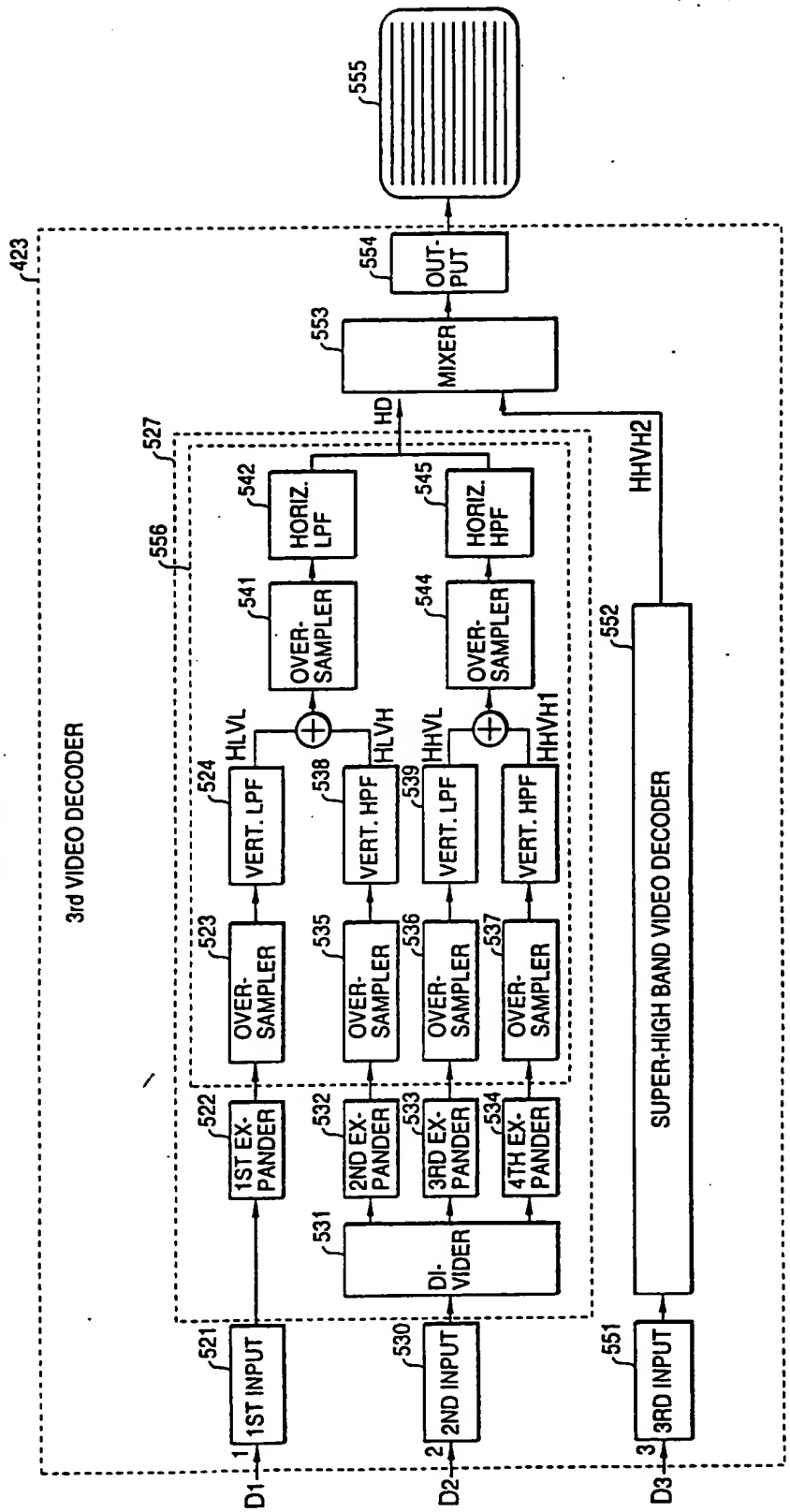

555
423
554
OUT-PUT
553
MIXER
HD
HHVH2
527
556
542
HORIZ. LPF
545
HORIZ. HPF
541
OVER-SAMPLER
544
OVER-SAMPLER
552
HLVL
HLVH
HHVL
HHVH1
524
VERT. LPF
538
VERT. HPF
539
VERT. LPF
VERT. HPF
523
OVER-SAMPLER
535
OVER-SAMPLER
536
OVER-SAMPLER
537
OVER-SAMPLER
522
1ST EX-PANDER
532
2ND EX-PANDER
533
3RD EX-PANDER
534
4TH EX-PANDER
531
DI-VIDER
SUPER-HIGH BAND VIDEO DECODER
521
1ST INPUT
530
2ND INPUT
551
3RD INPUT
3rd VIDEO DECODER
1
2
3
D1
D2
D3

FIG. 33

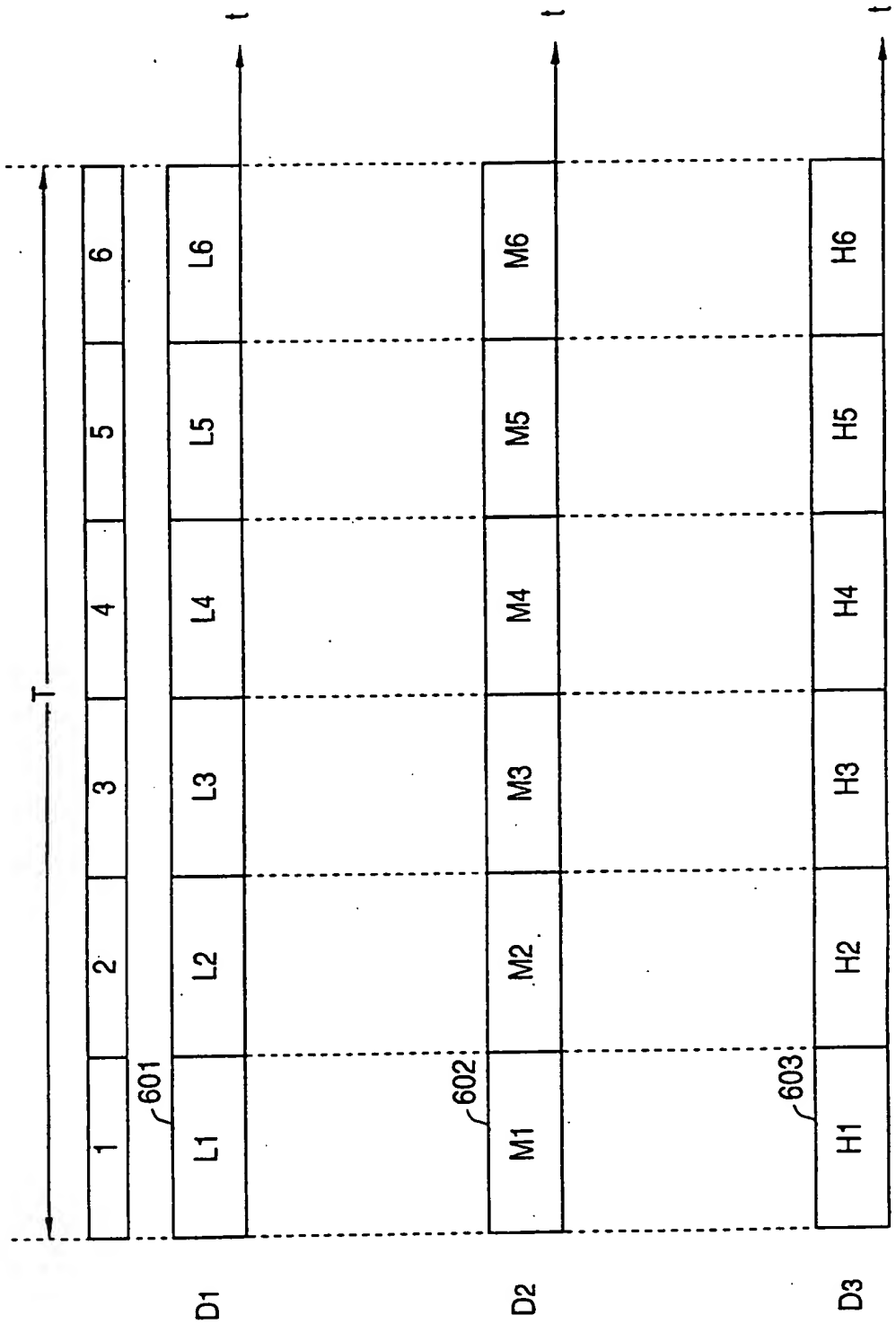

t
t
t
T
1
2
3
4
5
6
L1
L2
L3
L4
L5
L6
M1
M2
M3
M4
M5
M6
H1
H2
H3
H4
H5
H6
601
602
603
D1
D2
D3

FIG. 34

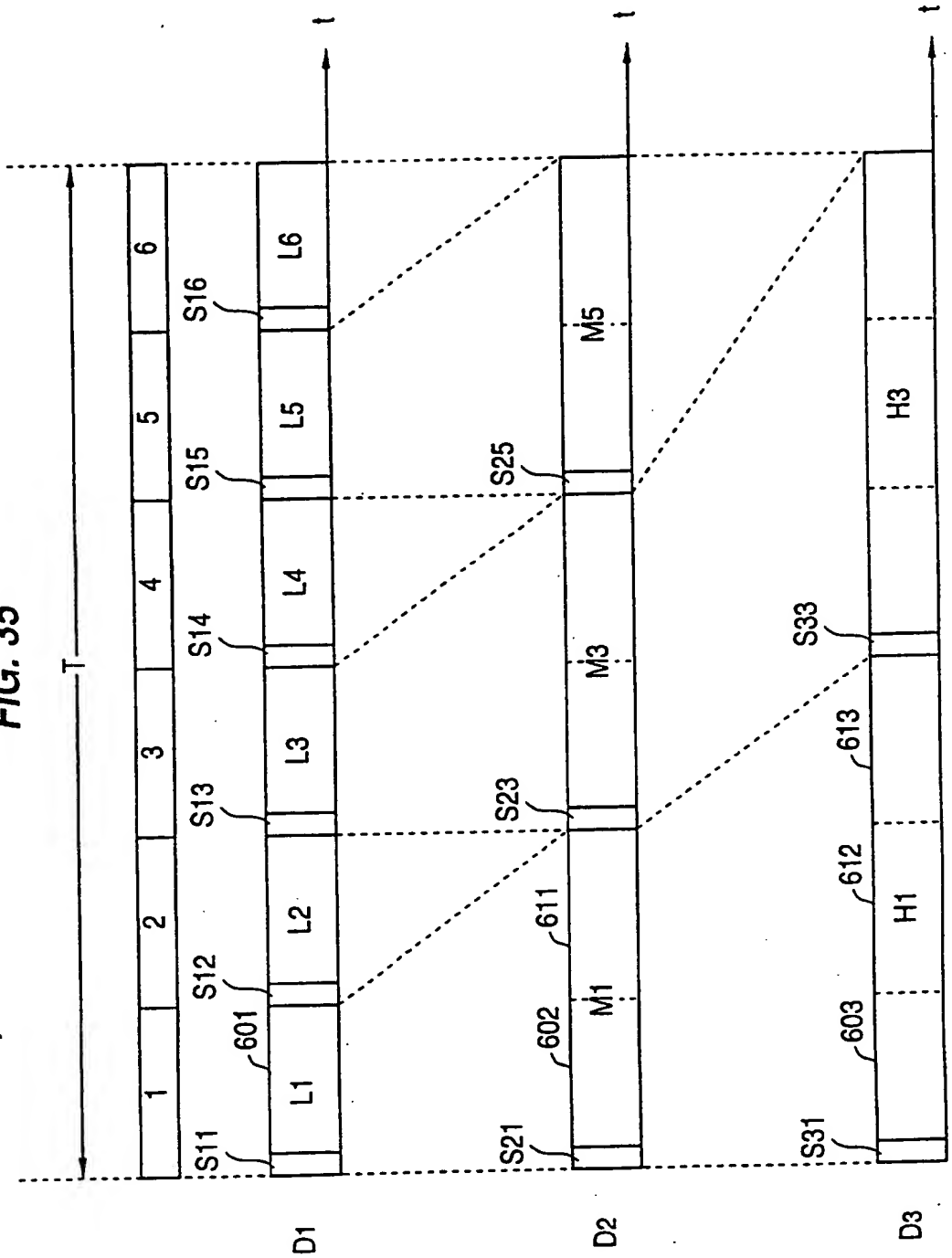

t
t
t
T
1
2
3
4
5
6
S11
S12
S13
S14
S15
S16
S21
S23
S25
S31
S33
601
602
603
611
612
613
L1
L2
L3
L4
L5
L6
M1
M3
M5
H1
H3
D1
D2
D3

FIG. 35

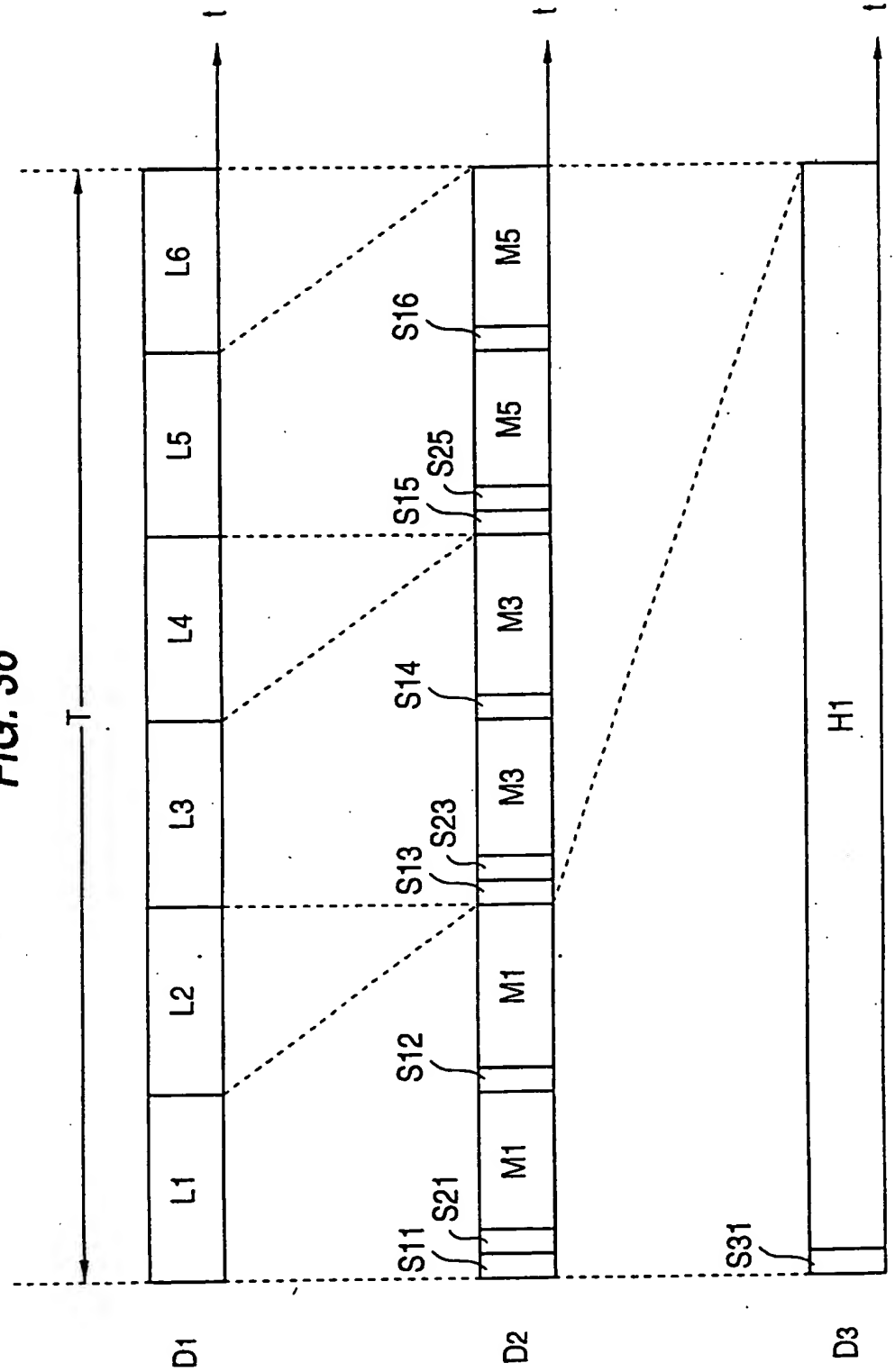

t
t
t
L6
L5
L4
L3
L2
L1
T
M5
M5
M3
M3
M1
M1
S16
S25
S15
S14
S23
S13
S12
S21
S11
H1
S31
D1
D2
D3

FIG. 36

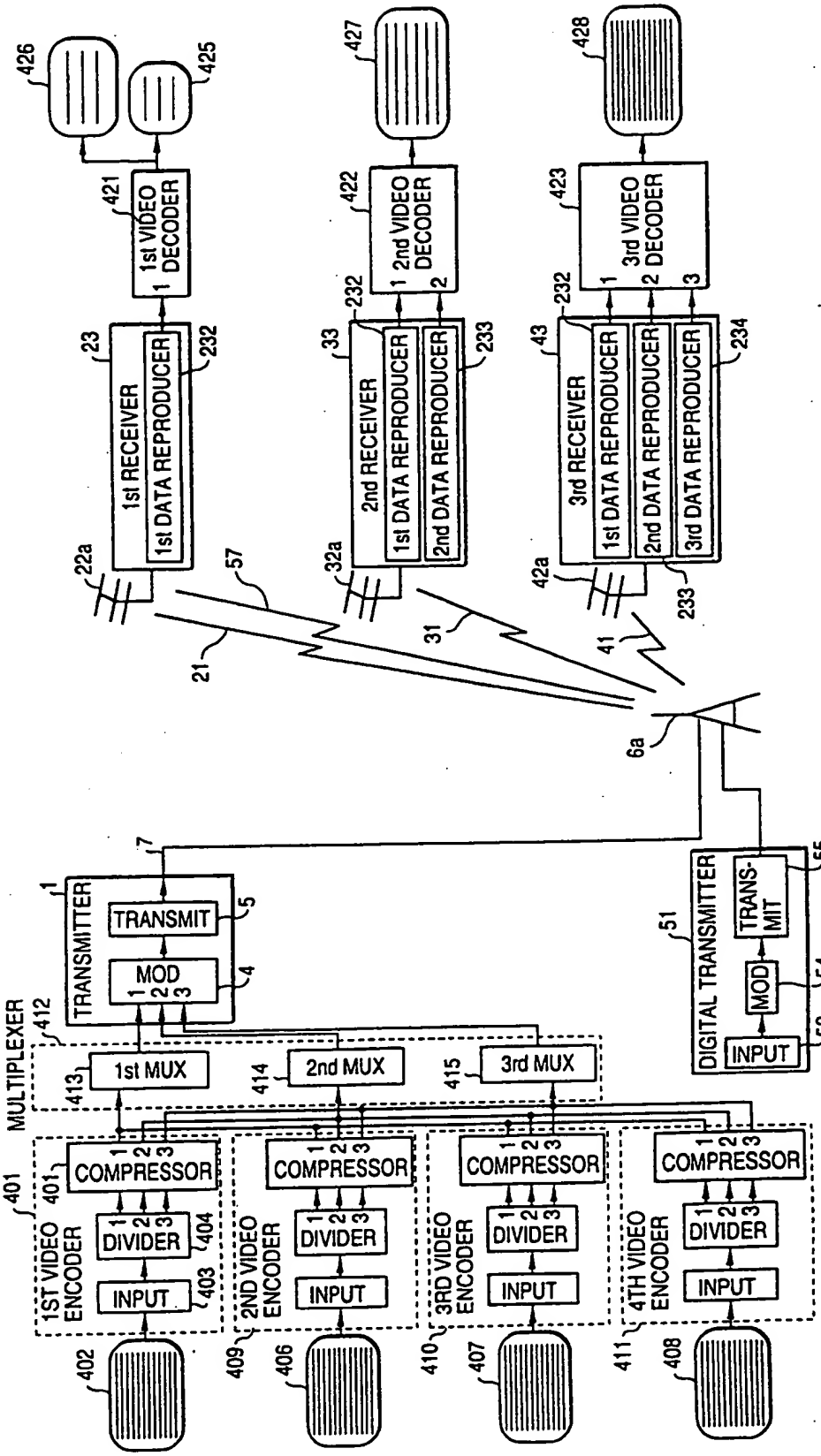

426
425
427
428
421
1st VIDEO DECODER
422
2nd VIDEO DECODER
423
3rd VIDEO DECODER
23
1st RECEIVER
1st DATA REPRODUCER
232
33
2nd RECEIVER
1st DATA REPRODUCER
2nd DATA REPRODUCER
233
43
3rd RECEIVER
1st DATA REPRODUCER
2nd DATA REPRODUCER
3rd DATA REPRODUCER
234
22a
32a
42a
57
21
31
41
6a
1
TRANSMITTER
7
TRANSMIT
5
MOD
4
MULTIPLEXER
412
1st MUX
413
2nd MUX
414
3rd MUX
415
51
DIGITAL TRANSMITTER
TRANS-MIT
55
MOD
54
INPUT
52
401
1ST VIDEO ENCODER
COMPRESSOR
DIVIDER
404
INPUT
403
2ND VIDEO ENCODER
3RD VIDEO ENCODER
4TH VIDEO ENCODER
402
409
406
410
407
411
408

FIG. 37

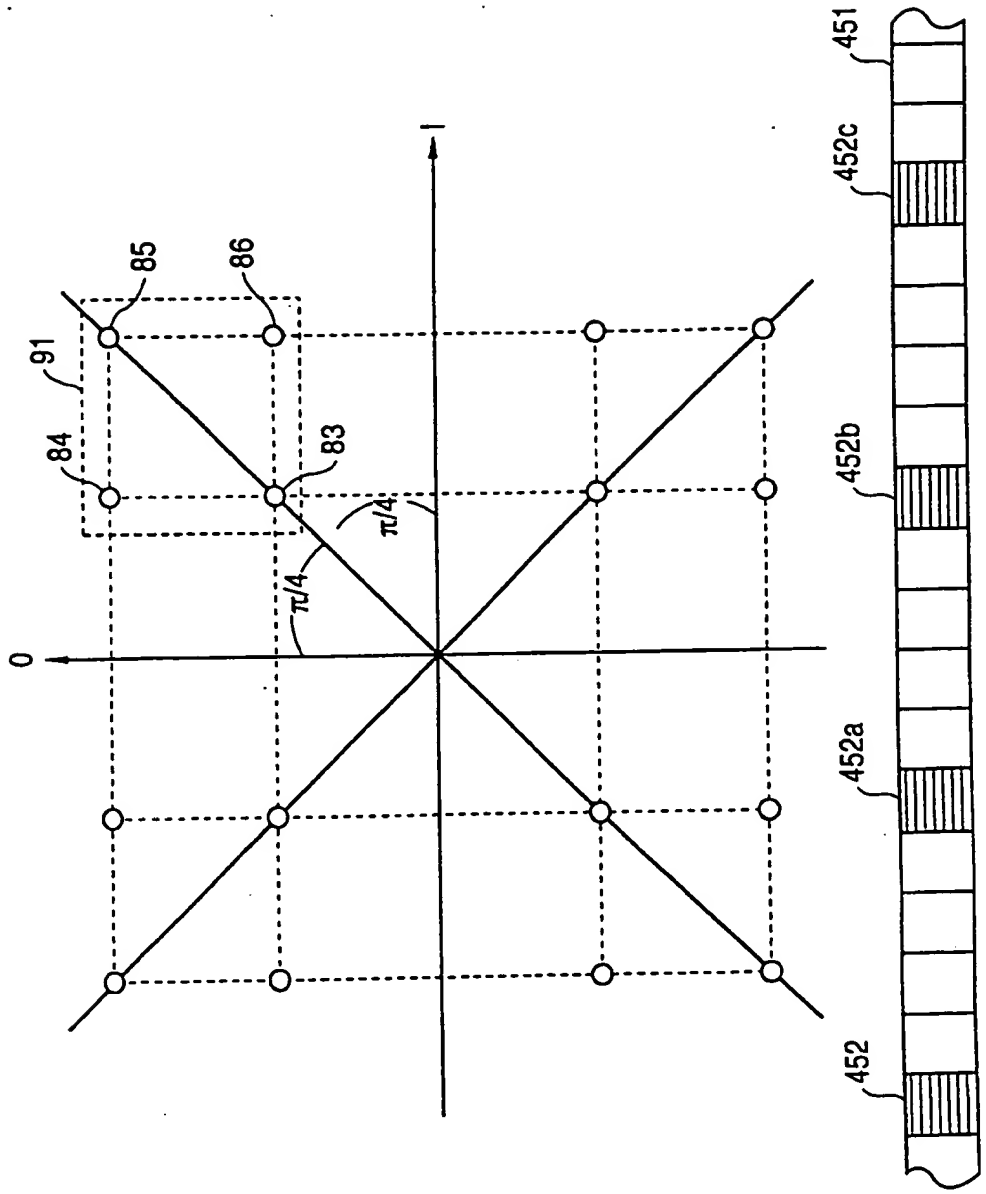


FIG. 38

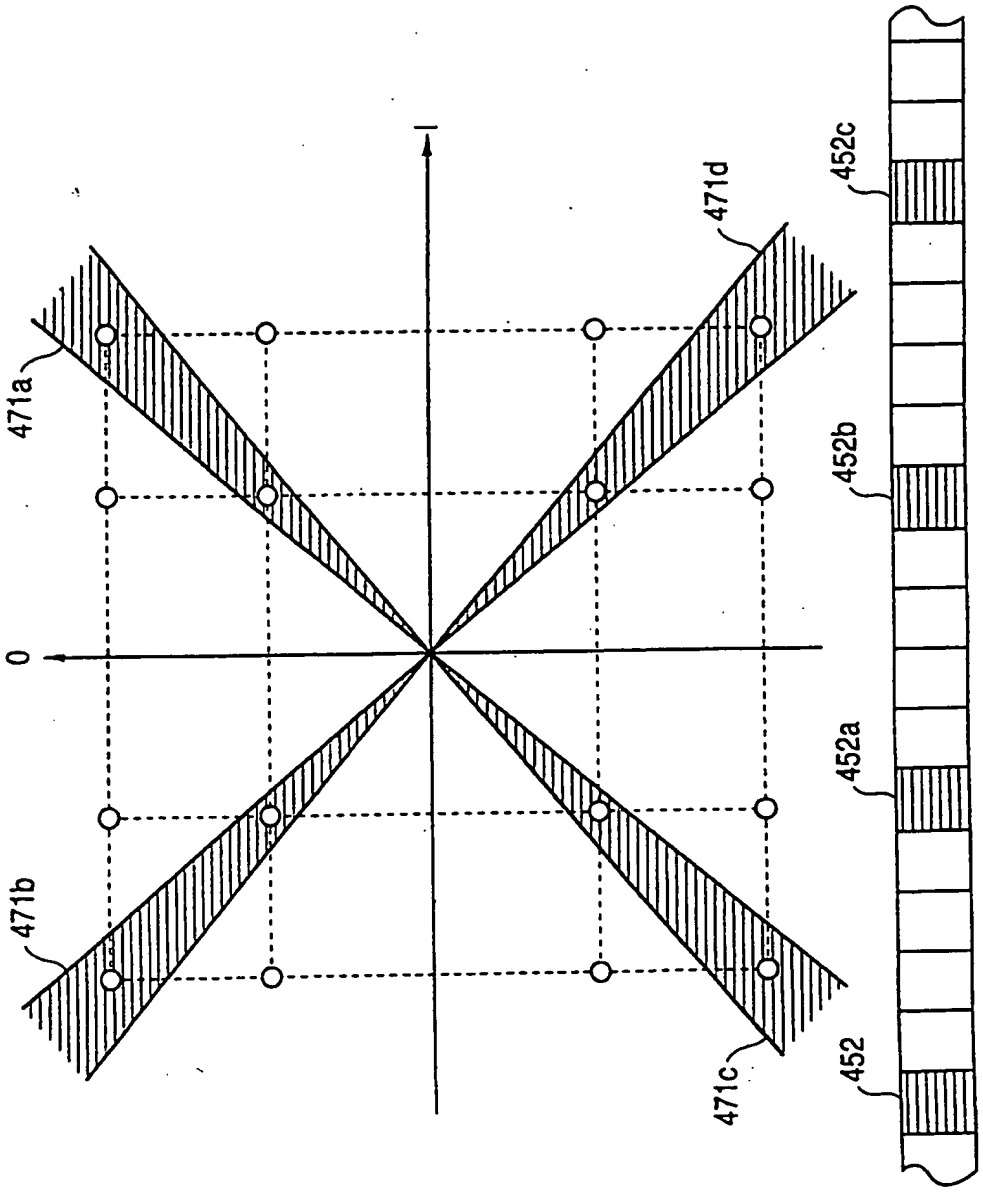


FIG. 39

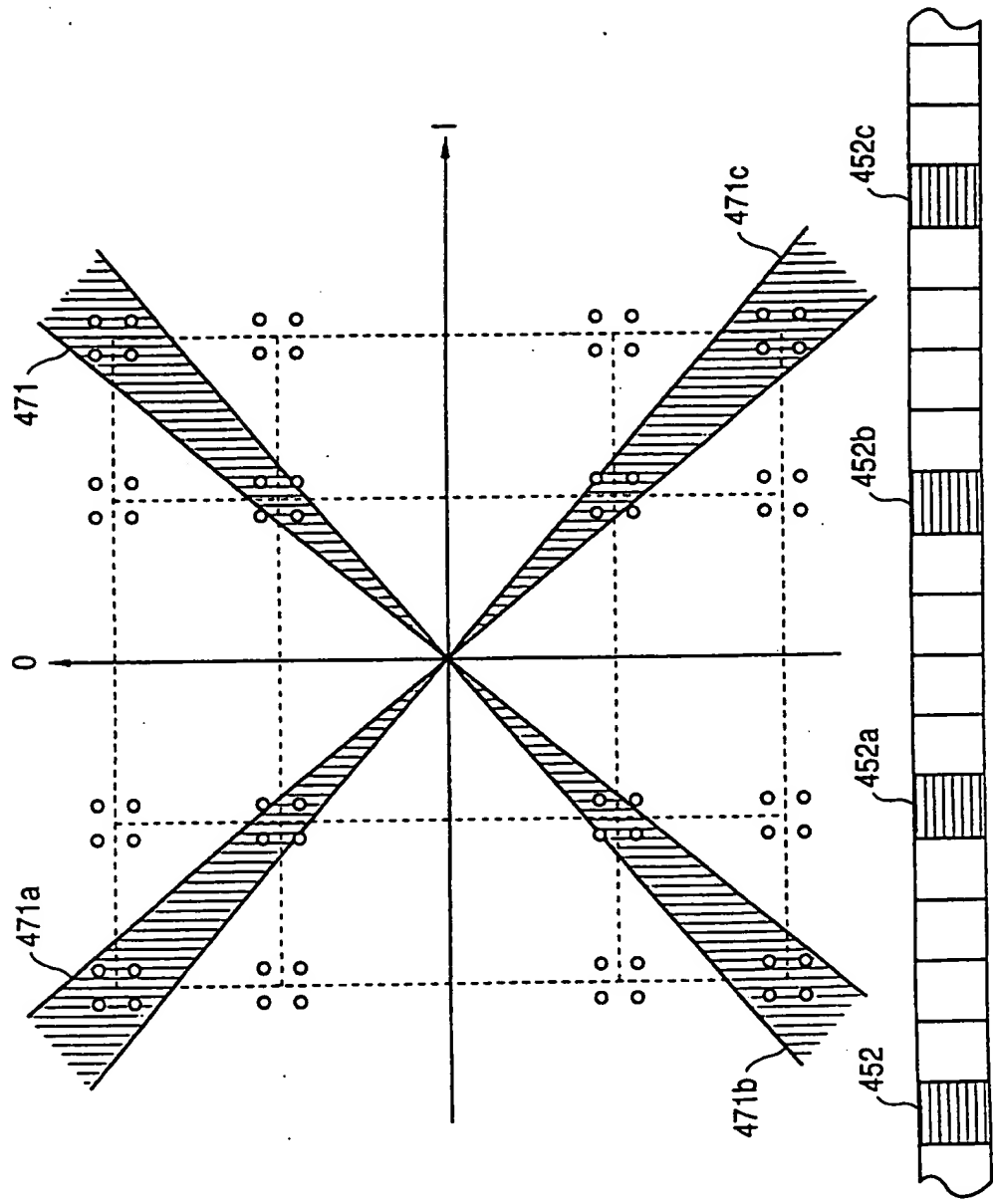


FIG. 40

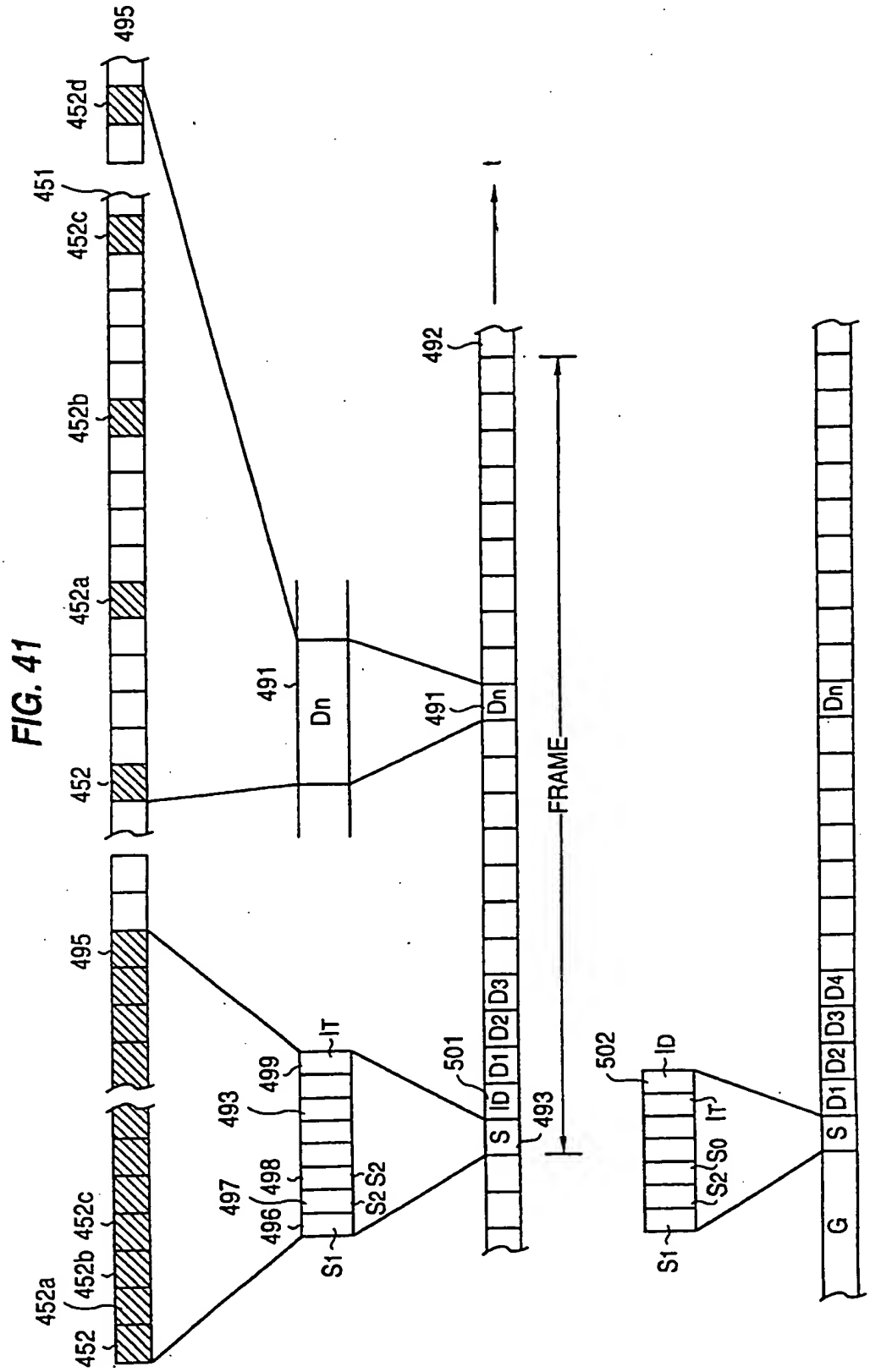

452
452a
452b
452c
452d
451
495
491
Dn
492
493
497
498
499
496
S1
S2
IT
501
S
ID
D1
D2
D3
FRAME
502
S0
G
D4

FIG. 41

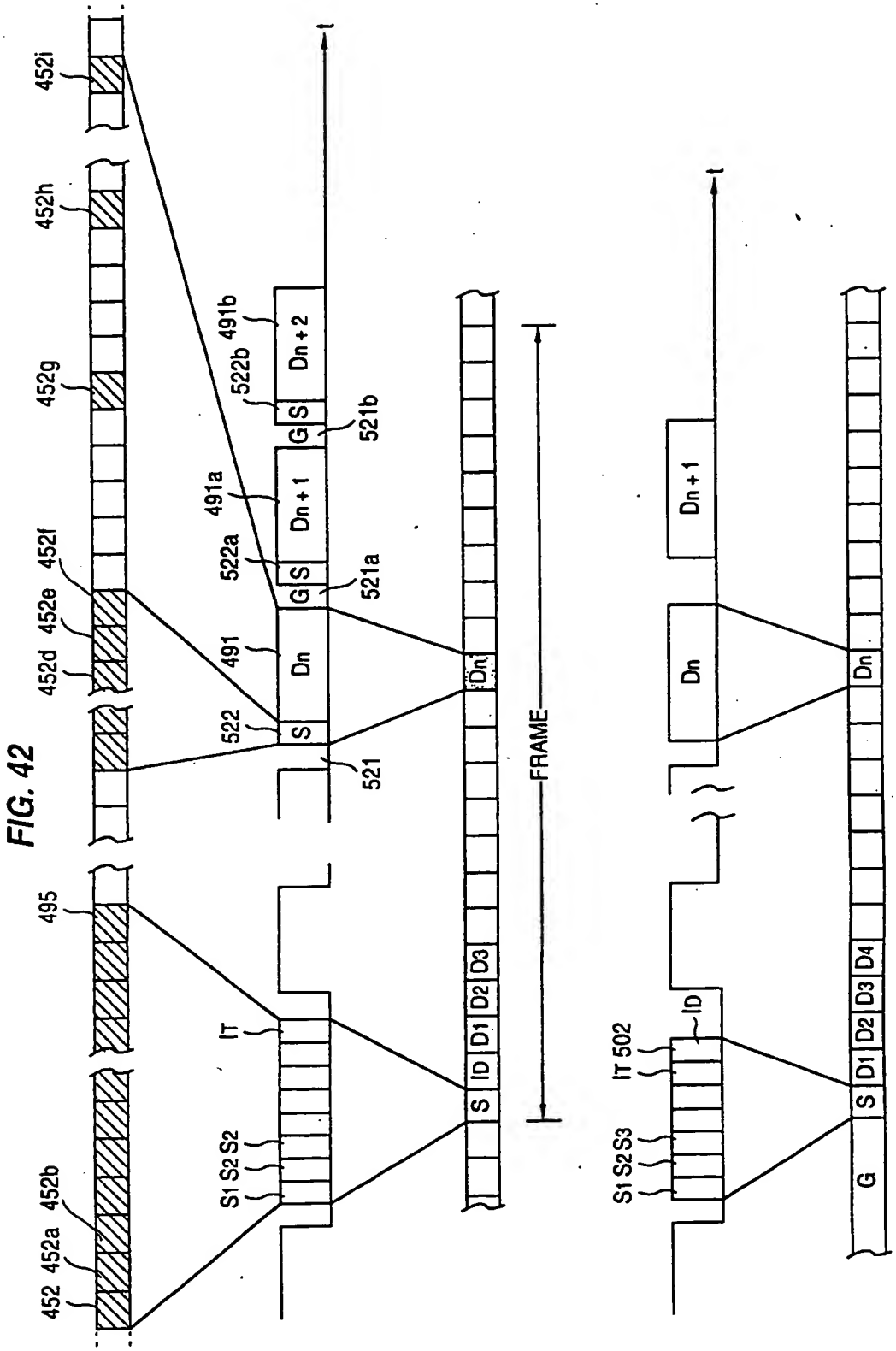

452i
452h
452g
452l
452e
452d
452
452a
452b
495
491b
522b
Dn+2
491a
522a
Dn+1
491
522
Dn
521b
521a
521
G
S
ID
D1
D2
D3
D4
IT
S1 S2 S3
IT 502
FRAME
t

FIG. 42

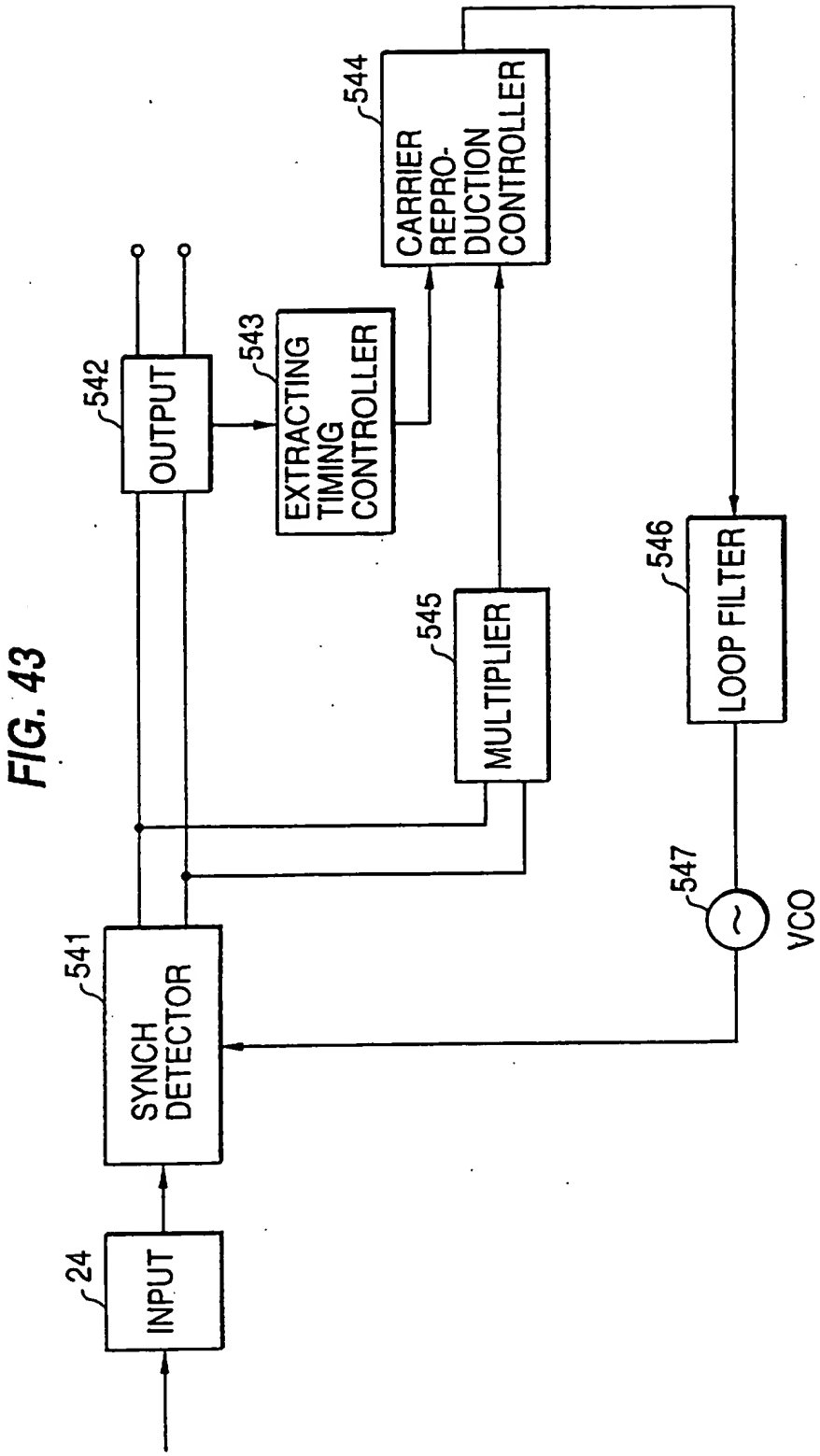

544
CARRIER REPRO-DUCTION CONTROLLER
543
EXTRACTING TIMING CONTROLLER
542
OUTPUT
546
LOOP FILTER
545
MULTIPLIER
547
VCO
541
SYNCH DETECTOR
24
INPUT

FIG. 43

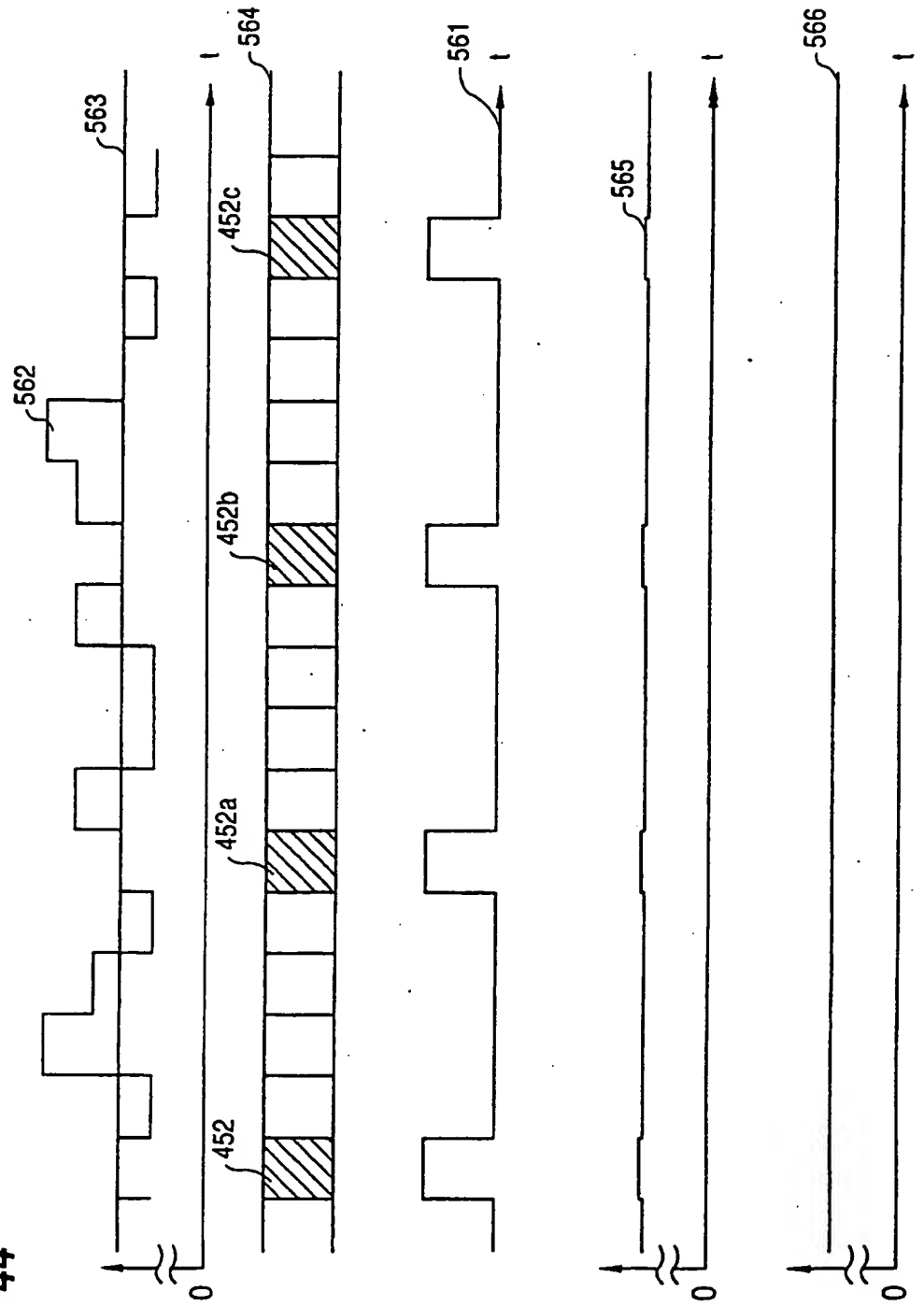


FIG. 44

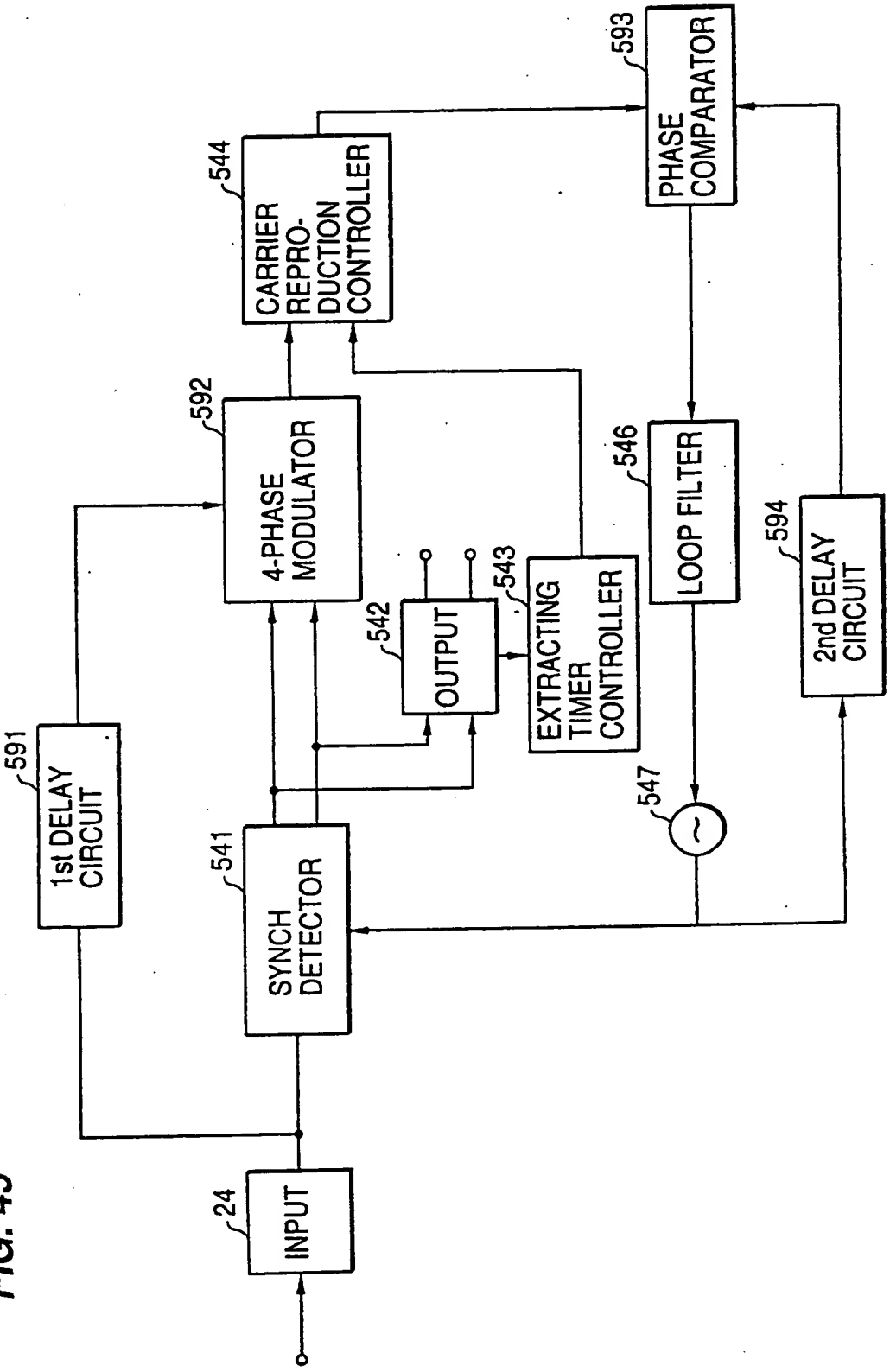

593
PHASE COMPARATOR
544
CARRIER REPRO-DUCTION CONTROLLER
592
4-PHASE MODULATOR
546
LOOP FILTER
594
2nd DELAY CIRCUIT
543
542
OUTPUT
EXTRACTING TIMER CONTROLLER
591
1st DELAY CIRCUIT
547
541
SYNCH DETECTOR
24
INPUT

FIG. 45

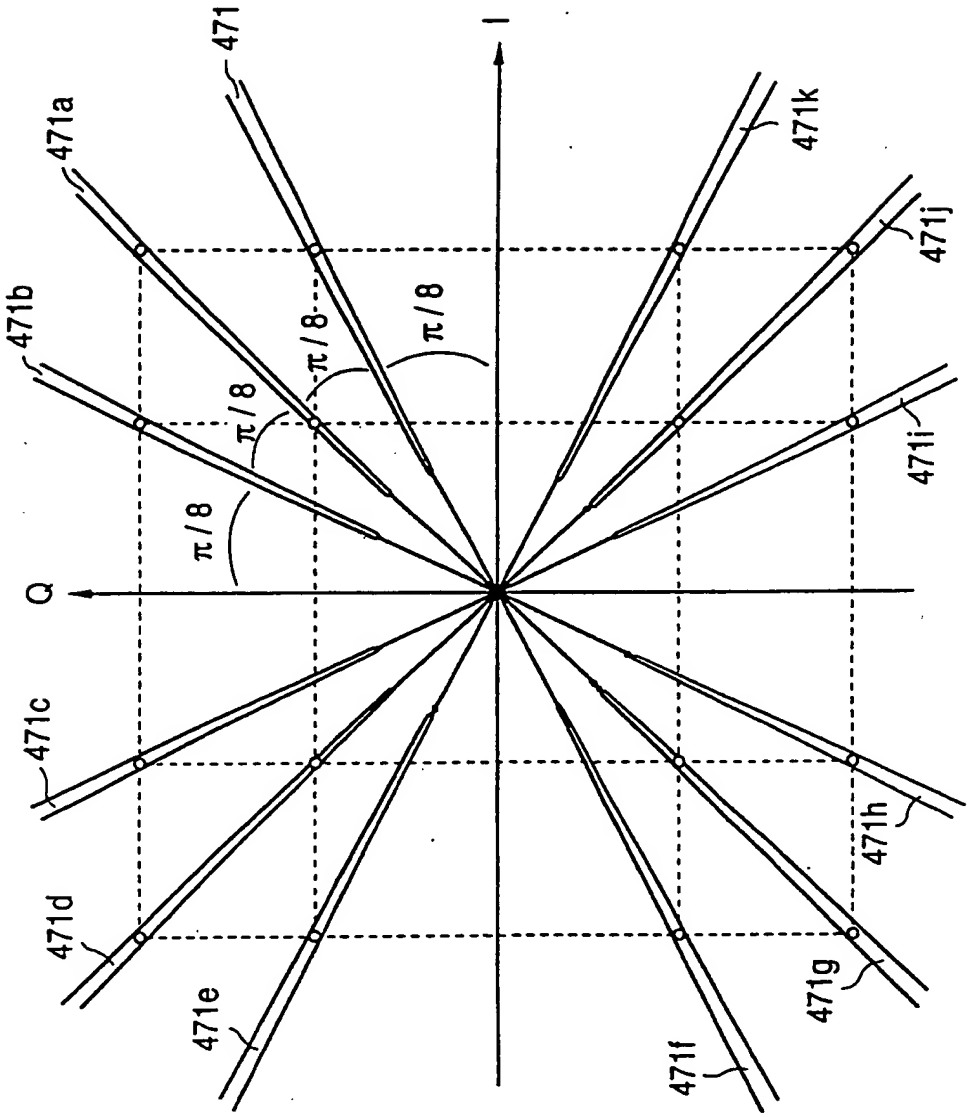

I
Q
471
471a
471b
471c
471d
471e
471f
471g
471h
471i
471j
471k
π/8
π/8
π/8
π/8

FIG. 46

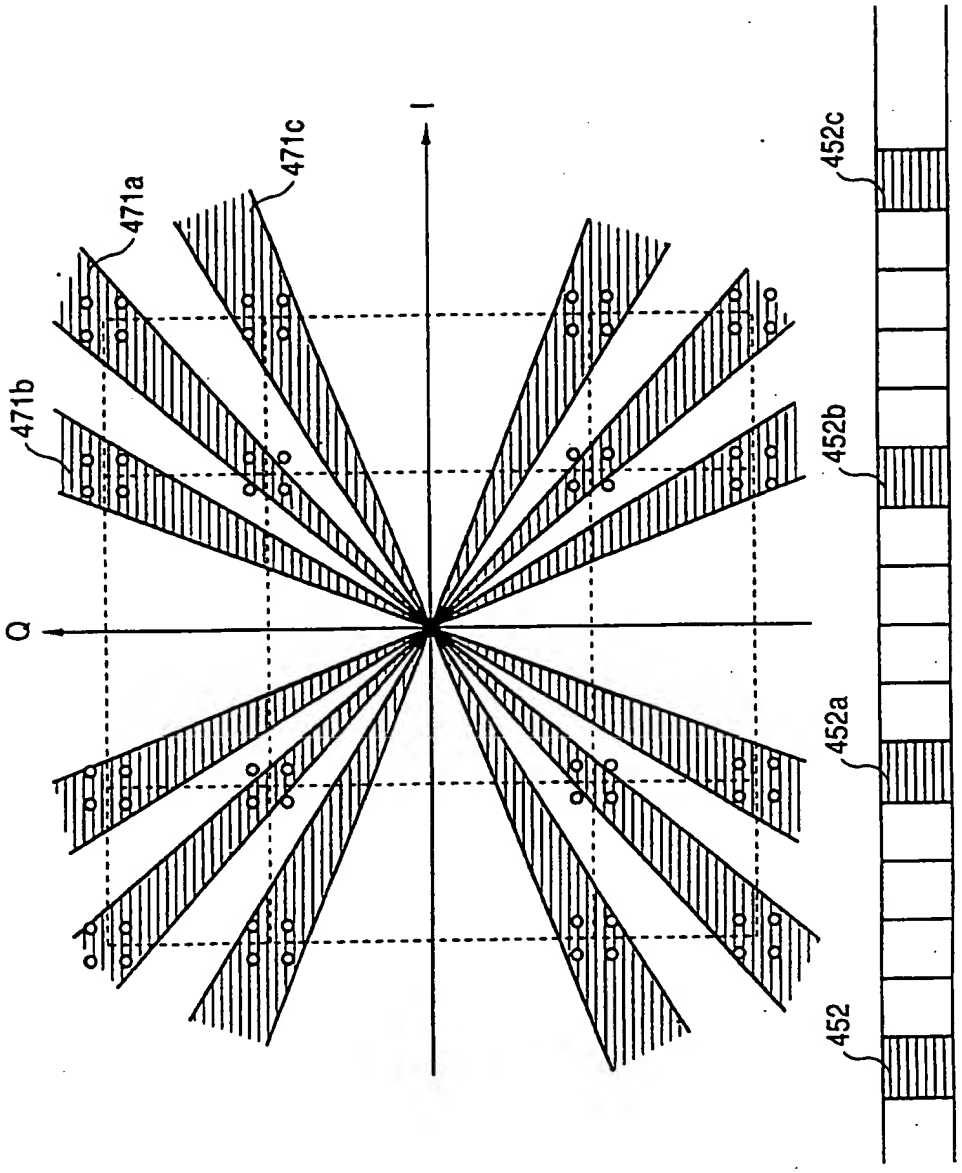


FIG. 47

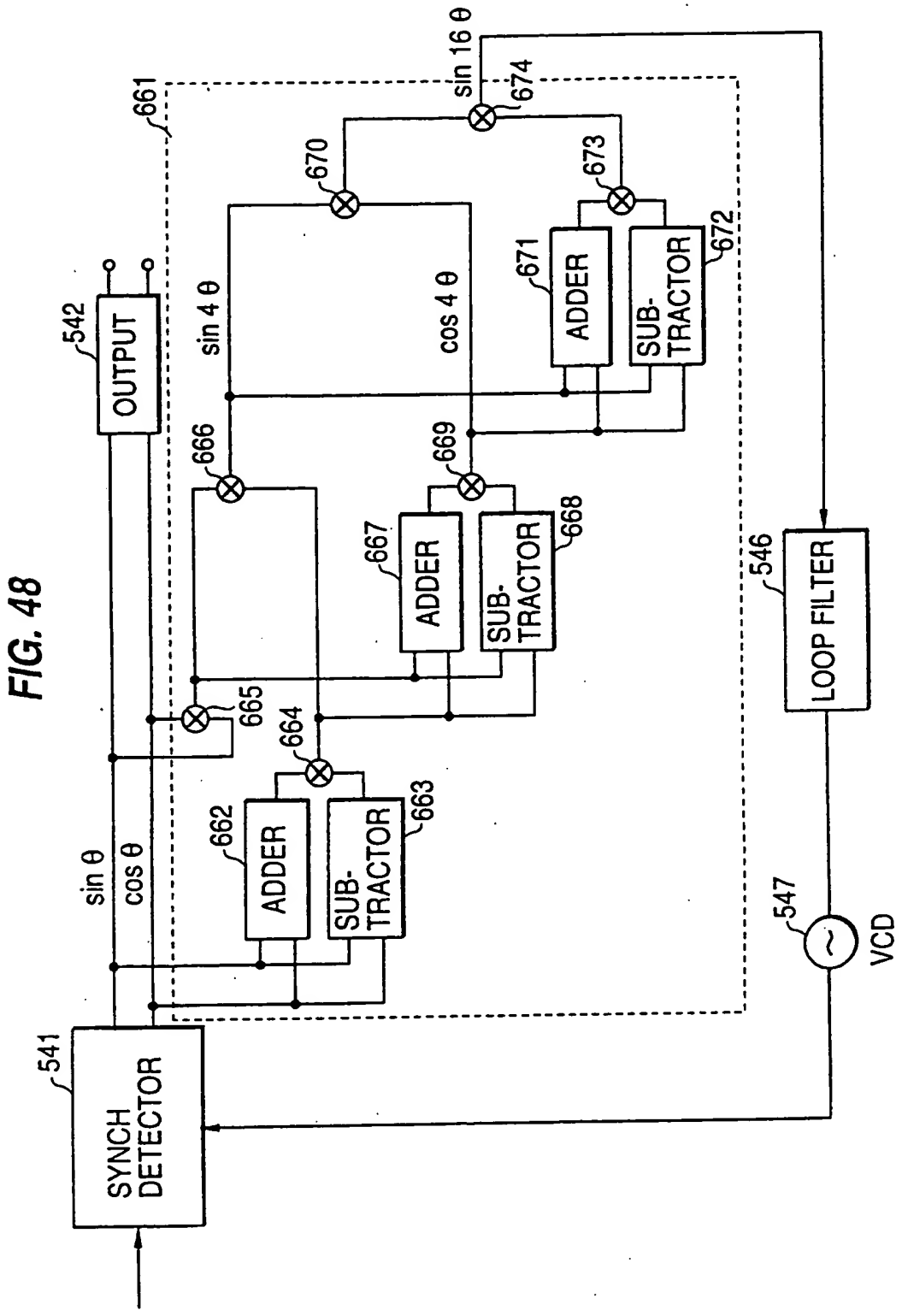

661
sin 16 θ
674
670
673
671
ADDER
672
SUB-
TRACTOR
542
OUTPUT
sin 4 θ
cos 4 θ
666
669
667
ADDER
668
SUB-
TRACTOR
546
LOOP FILTER
665
664
662
ADDER
663
SUB-
TRACTOR
sin θ
cos θ
547
VCD
541
SYNCH
DETECTOR

FIG. 48

FIG. 49

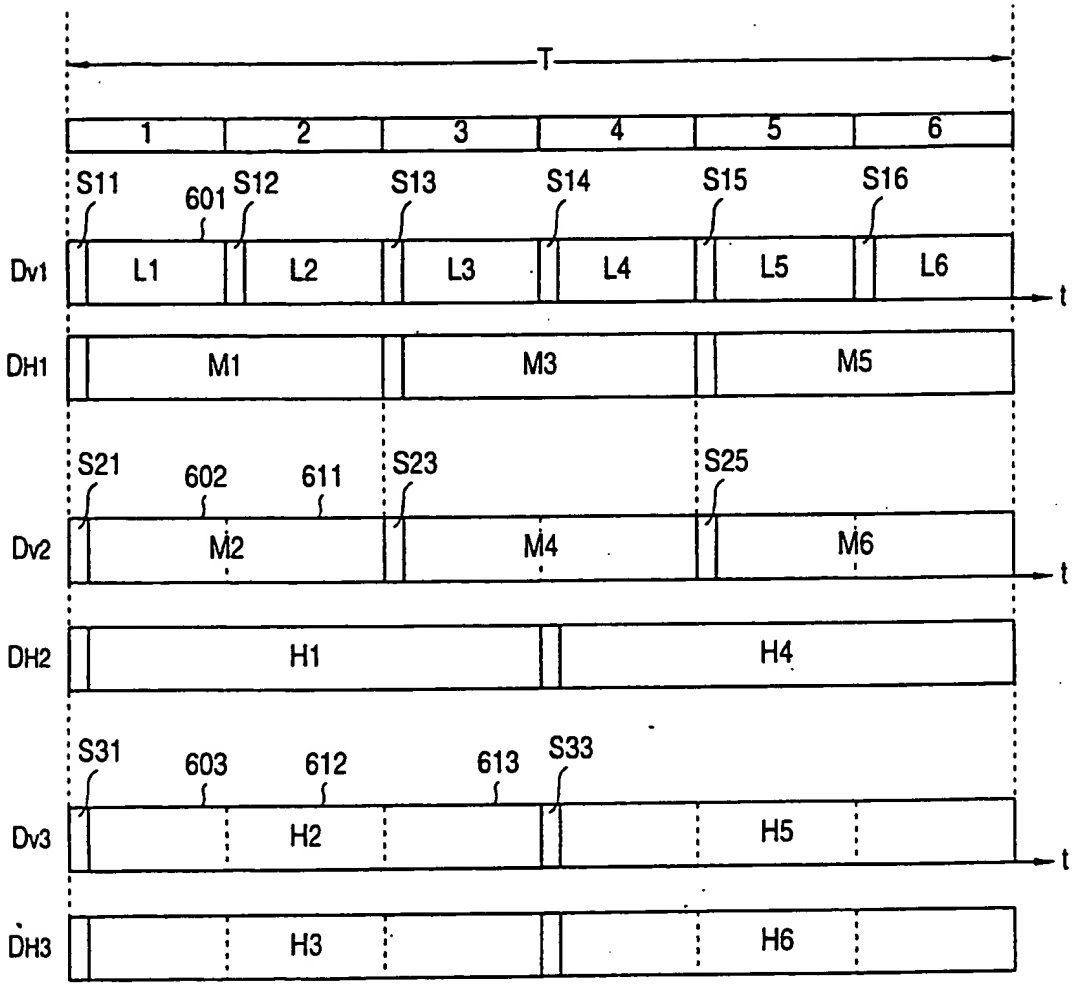
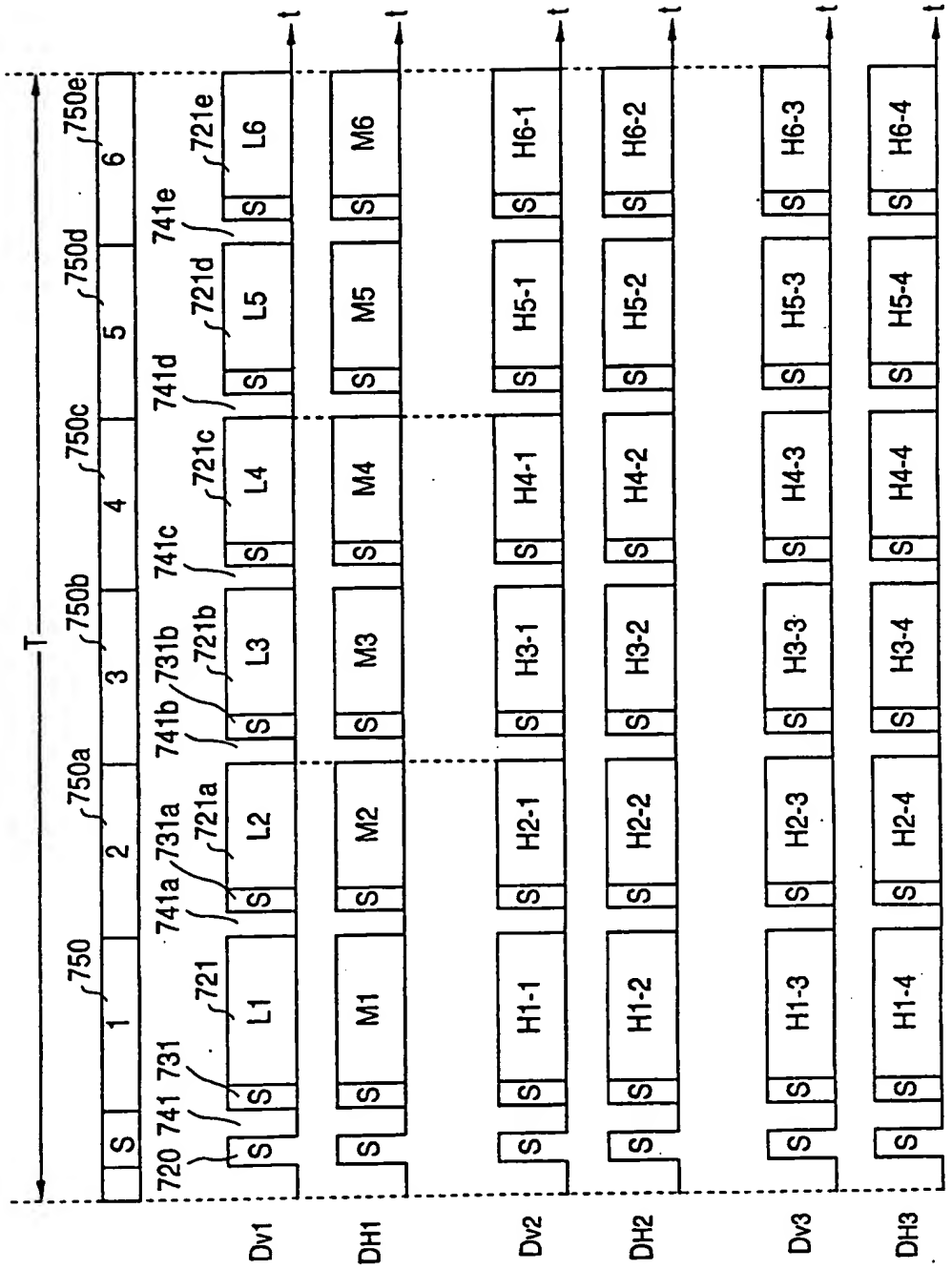

T
1
2
3
4
5
6
S11
601
S12
S13
S14
S15
S16
Dv1
L1
L2
L3
L4
L5
L6
t
DH1
M1
M3
M5
S21
602
611
S23
S25
Dv2
M2
M4
M6
t
DH2
H1
H4
S31
603
612
613
S33
Dv3
H2
H5
t
DH3
H3
H6

FIG. 50


T
t
S
1
2
3
4
5
6
720
741
731
721
741a
731a
721a
741b
731b
721b
741c
721c
741d
721d
741e
721e
750
750a
750b
750c
750d
750e
L1
L2
L3
L4
L5
L6
M1
M2
M3
M4
M5
M6
H1-1
H1-2
H1-3
H1-4
H2-1
H2-2
H2-3
H2-4
H3-1
H3-2
H3-3
H3-4
H4-1
H4-2
H4-3
H4-4
H5-1
H5-2
H5-3
H5-4
H6-1
H6-2
H6-3
H6-4
Dv1
DH1
Dv2
DH2
Dv3
DH3

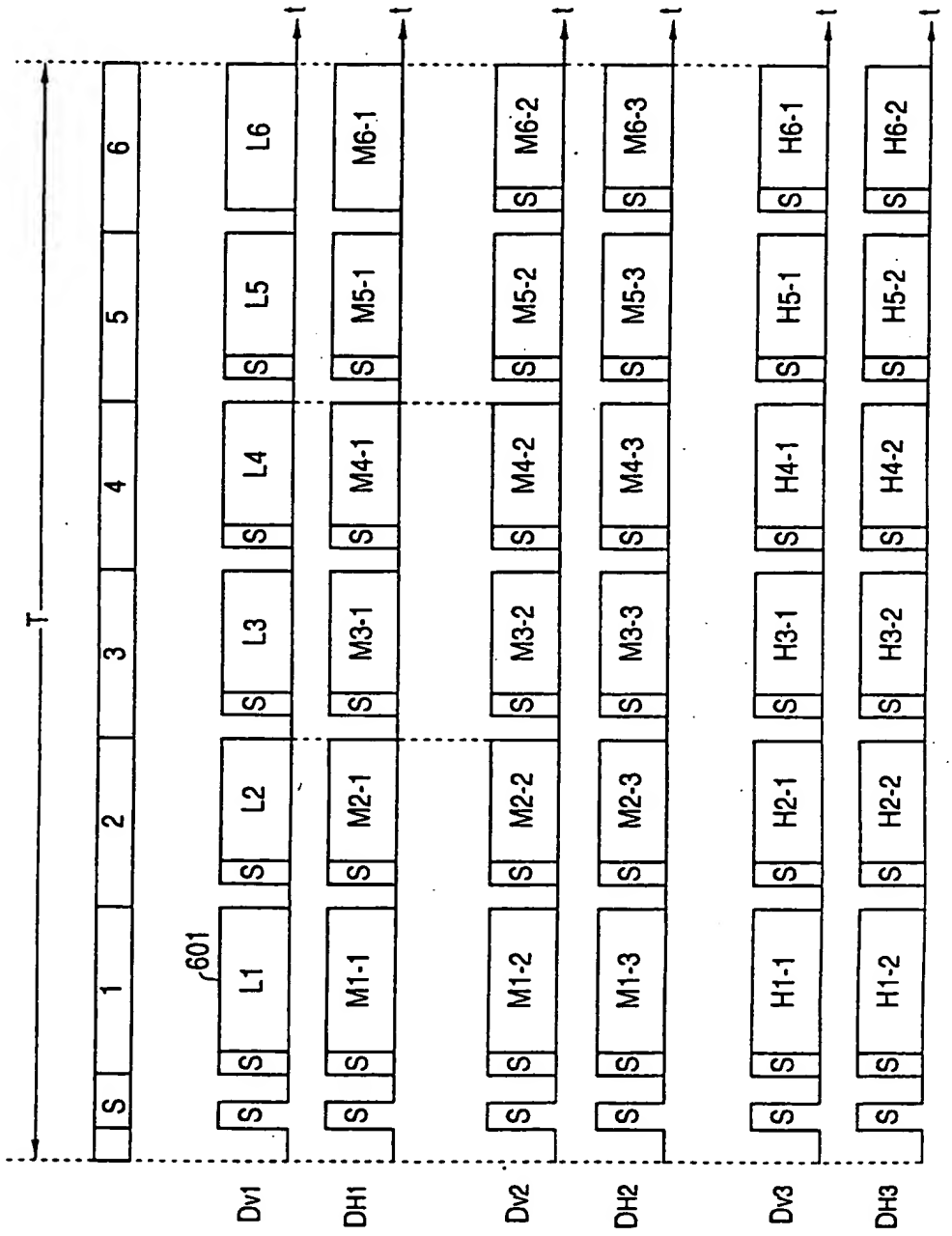

T
S
1
2
3
4
5
6
601
L1
L2
L3
L4
L5
L6
M1-1
M2-1
M3-1
M4-1
M5-1
M6-1
M1-2
M2-2
M3-2
M4-2
M5-2
M6-2
M1-3
M2-3
M3-3
M4-3
M5-3
M6-3
H1-1
H2-1
H3-1
H4-1
H5-1
H6-1
H1-2
H2-2
H3-2
H4-2
H5-2
H6-2
Dv1
DH1
Dv2
DH2
Dv3
DH3

FIG. 51

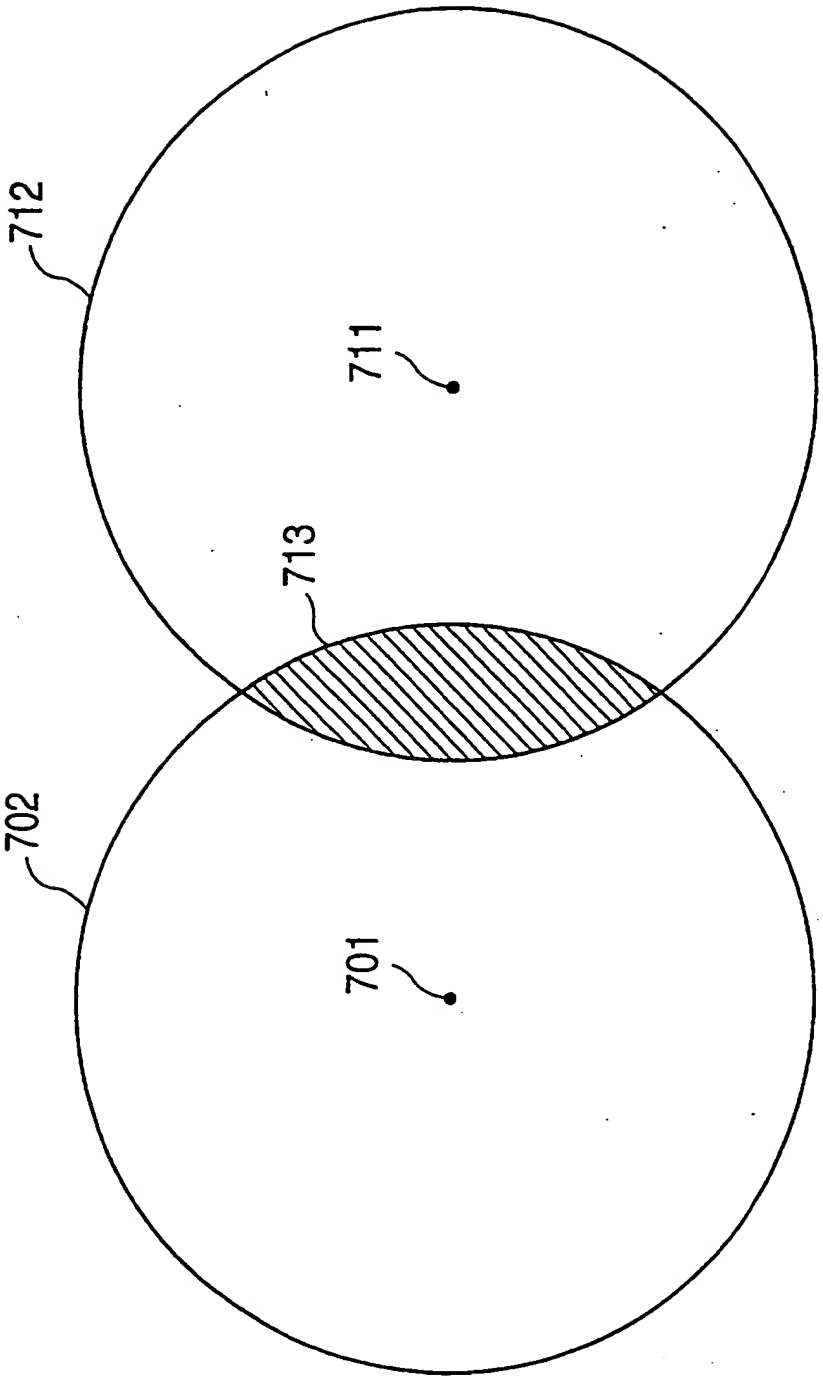


FIG. 52

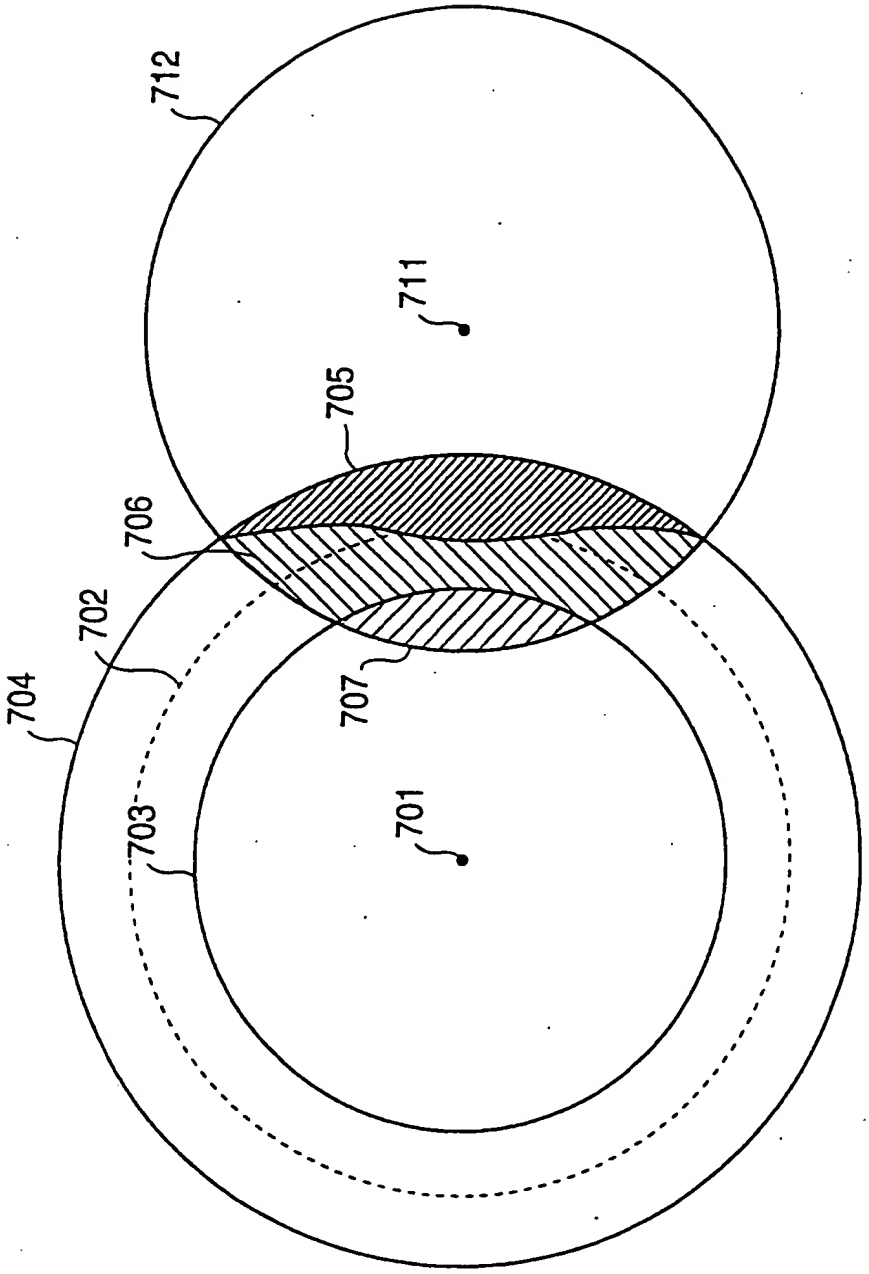


FIG. 53

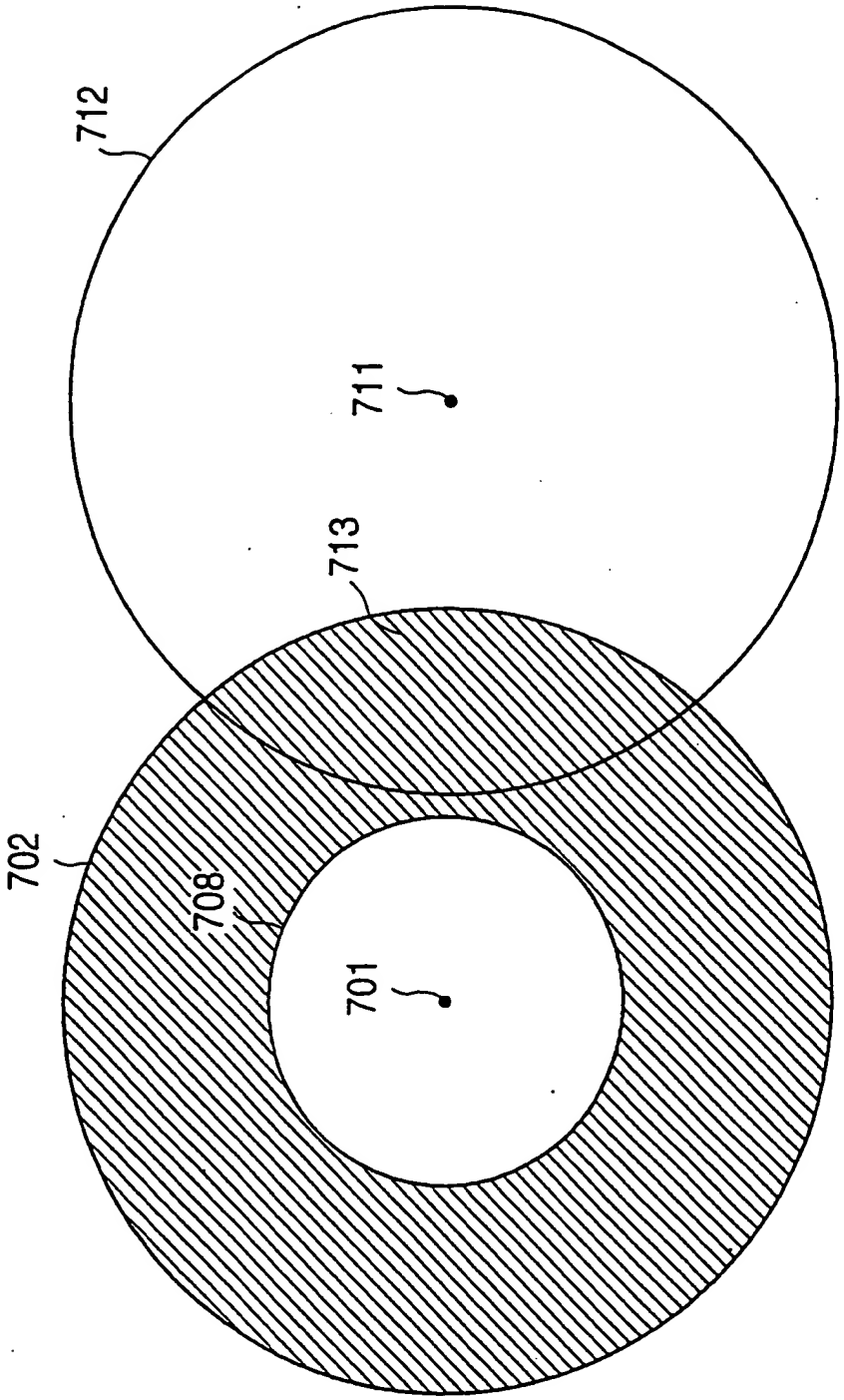
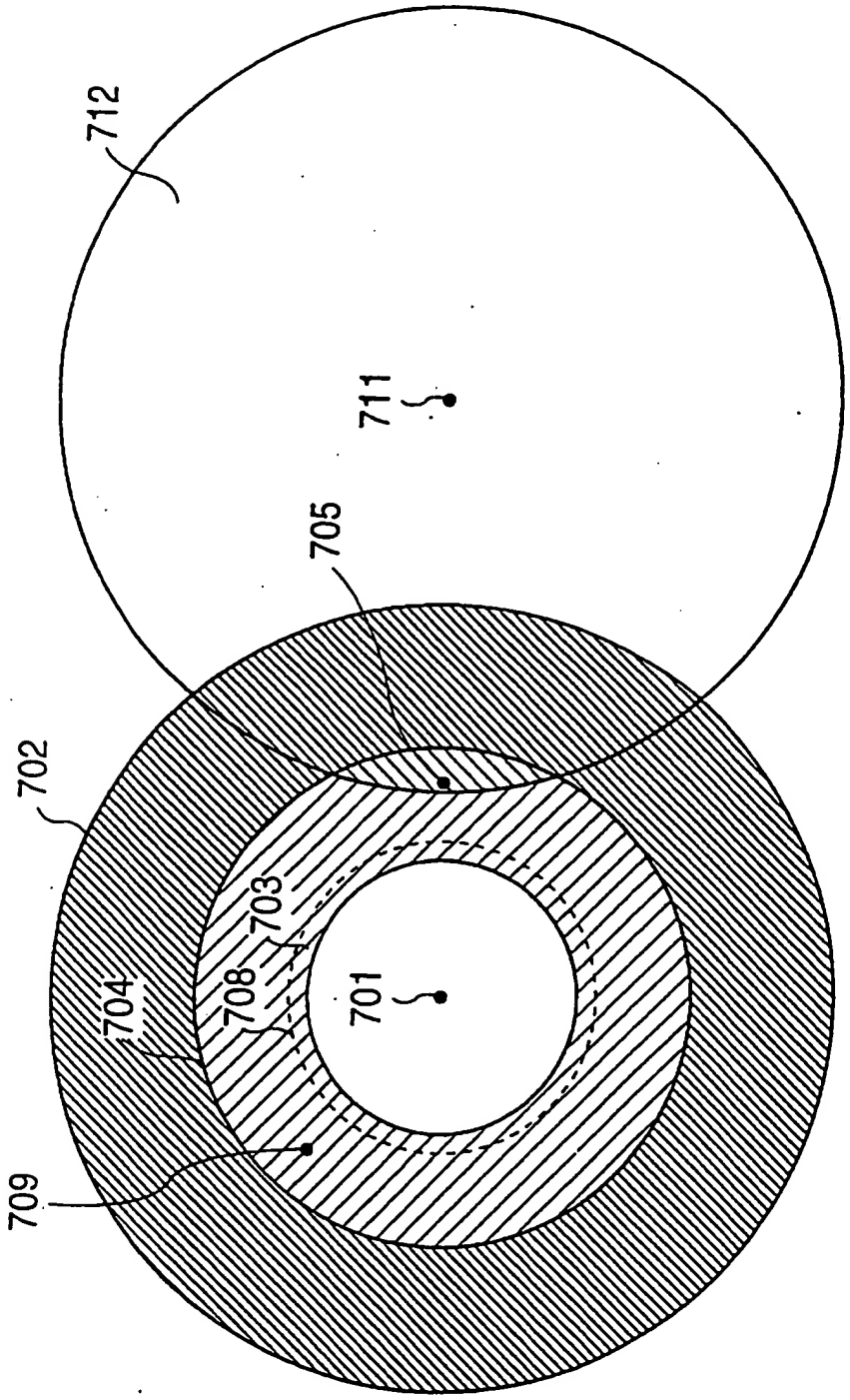


FIG. 54

FIG. 55



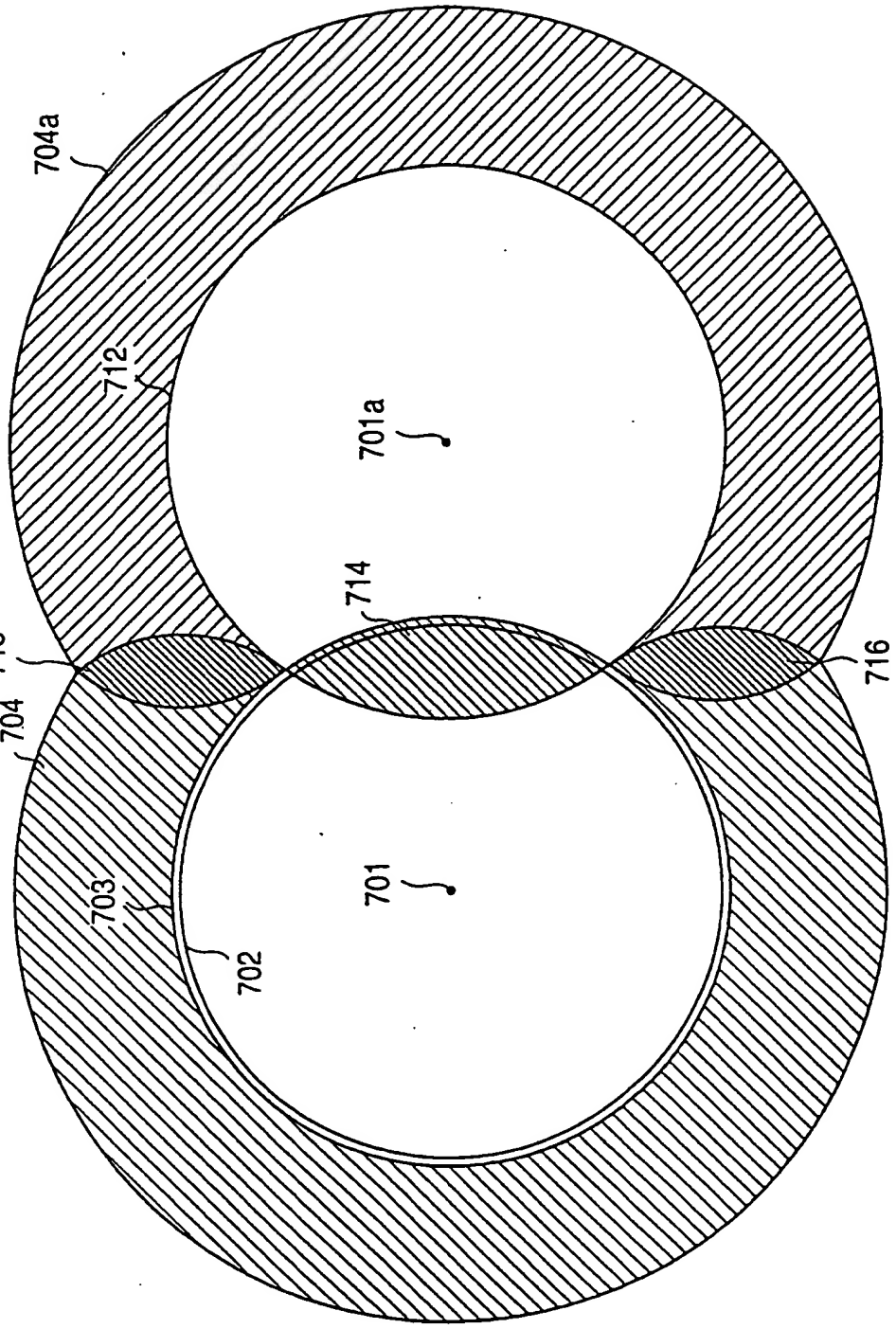


FIG. 56

FIG. 57

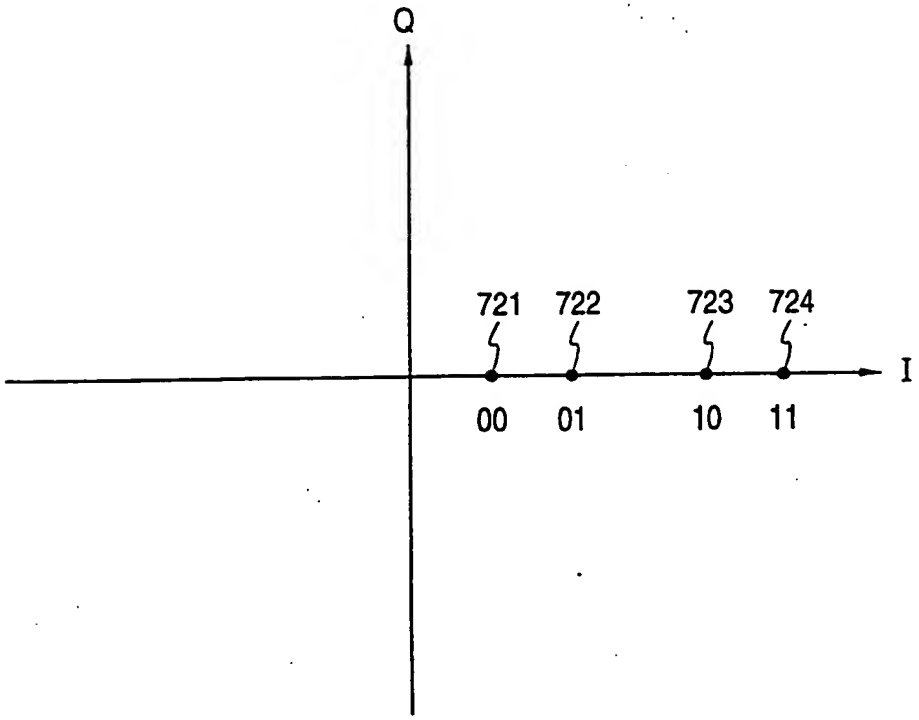
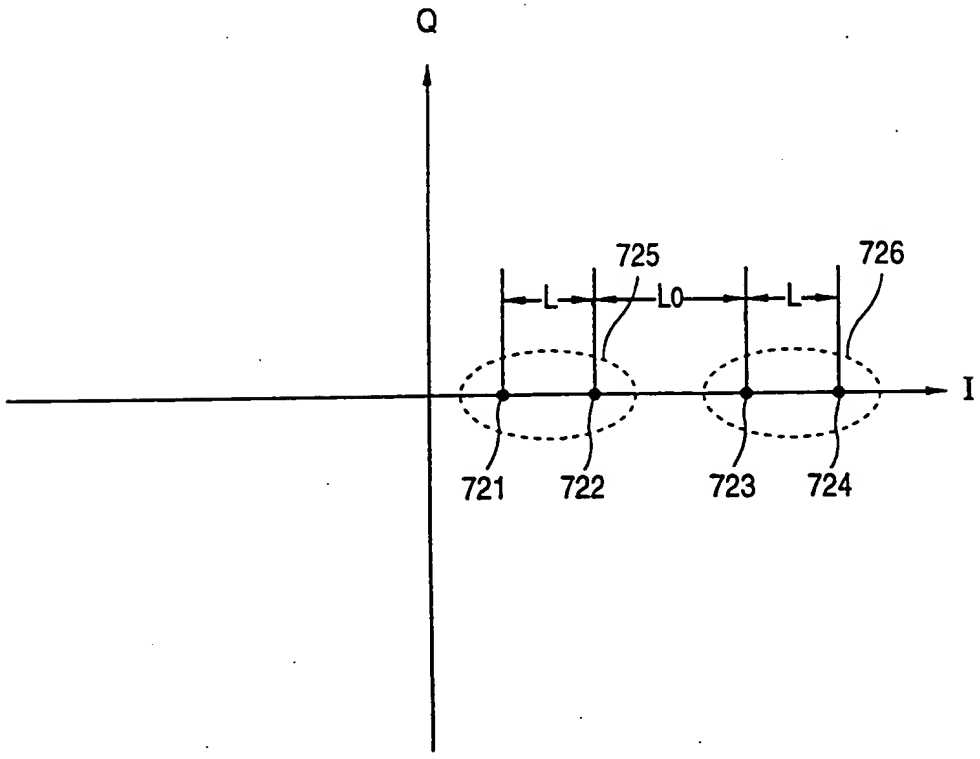


FIG. 58



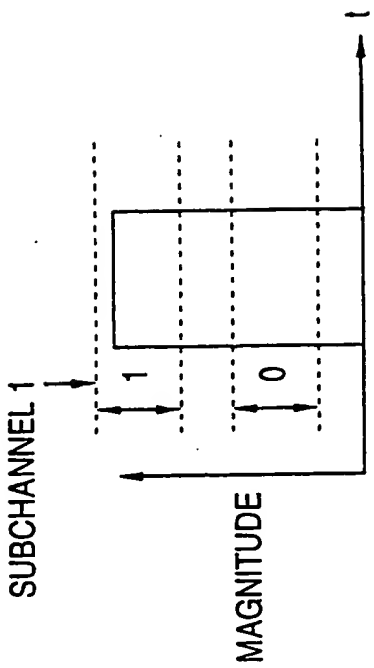


FIG. 59(c)

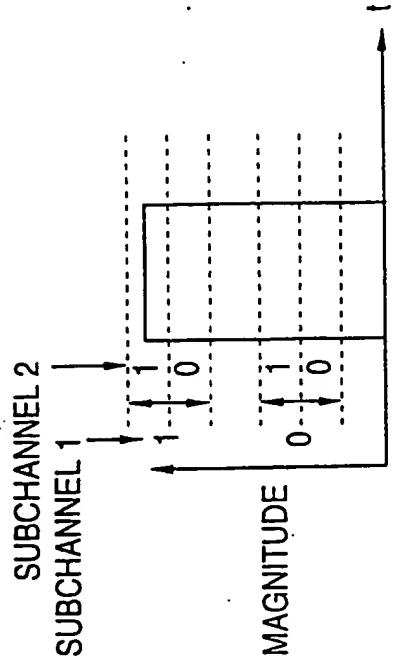


FIG. 59(d)

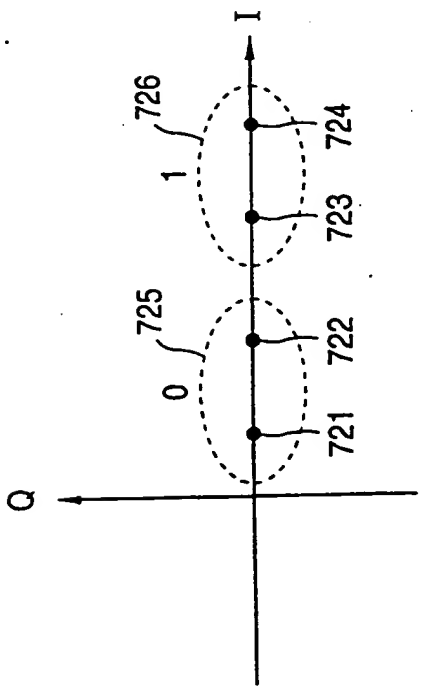


FIG. 59(a)

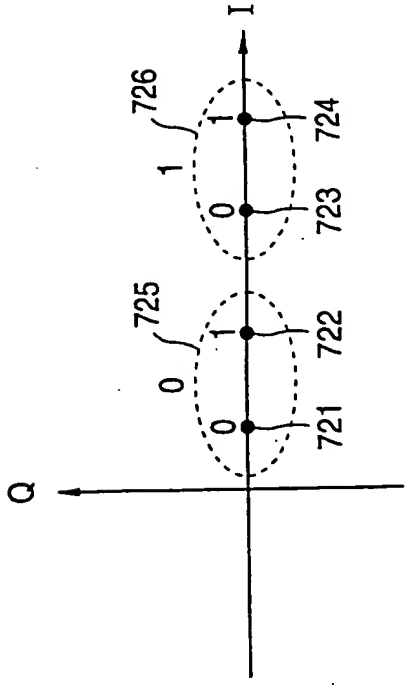


FIG. 59(b)

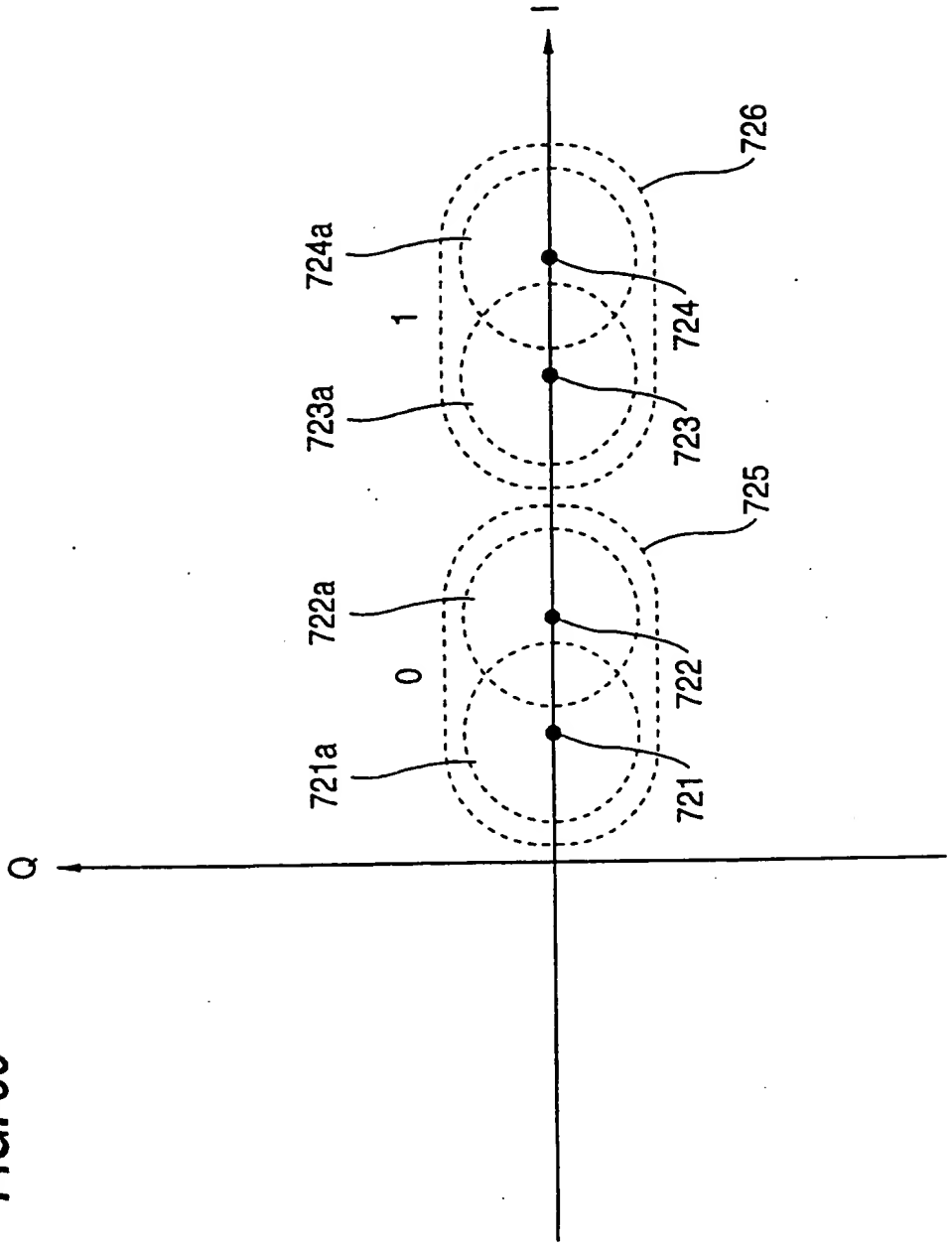


FIG. 60

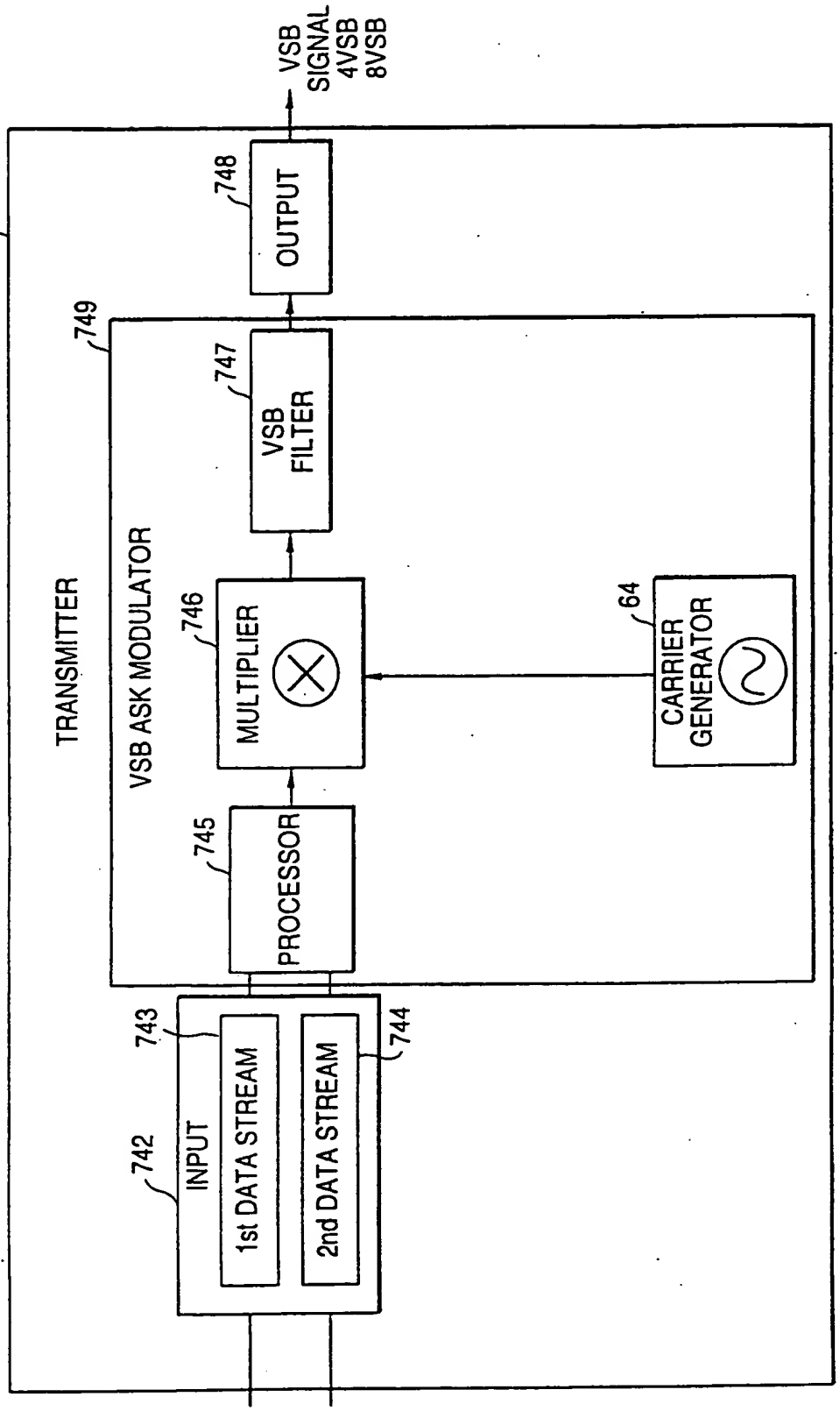

VSB SIGNAL 4VSB 8VSB
741
748
OUTPUT
749
747
VSB FILTER
TRANSMITTER
VSB ASK MODULATOR
746
MULTIPLIER
64
CARRIER GENERATOR
745
PROCESSOR
743
744
742
INPUT
1st DATA STREAM
2nd DATA STREAM

FIG. 61

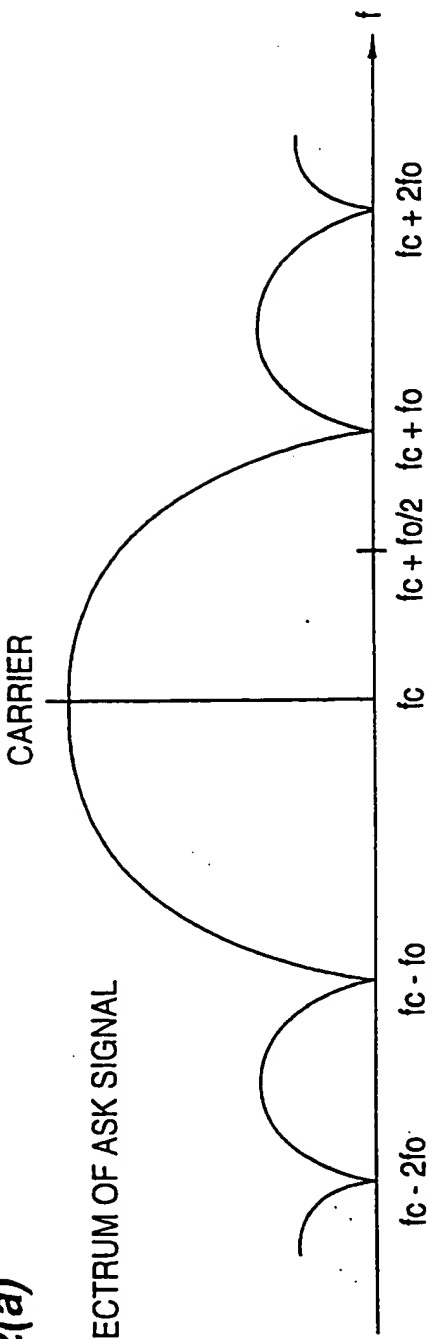


FIG. 62(a)

SPECTRUM OF ASK SIGNAL

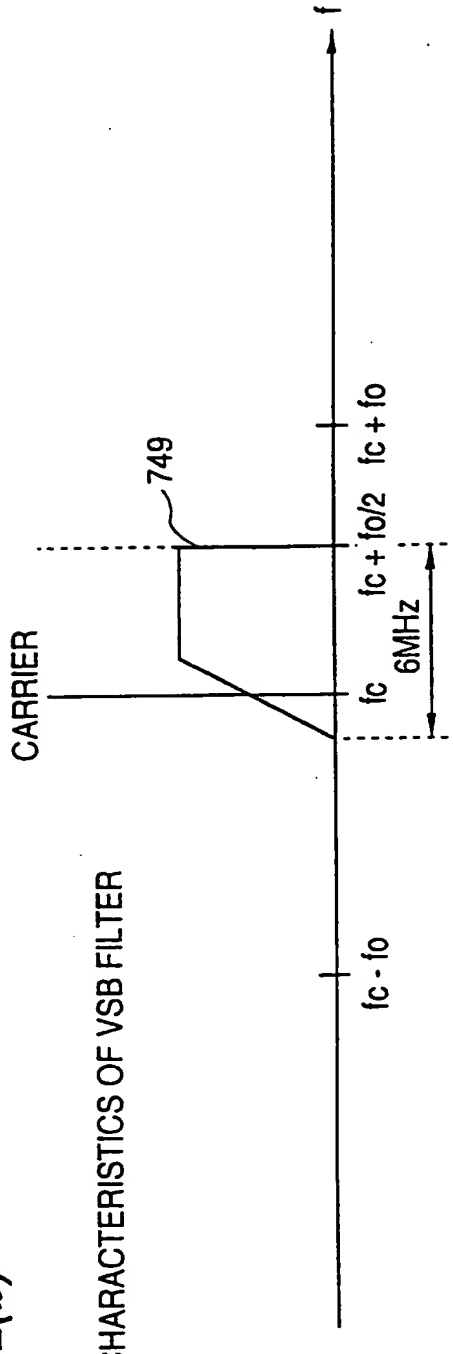
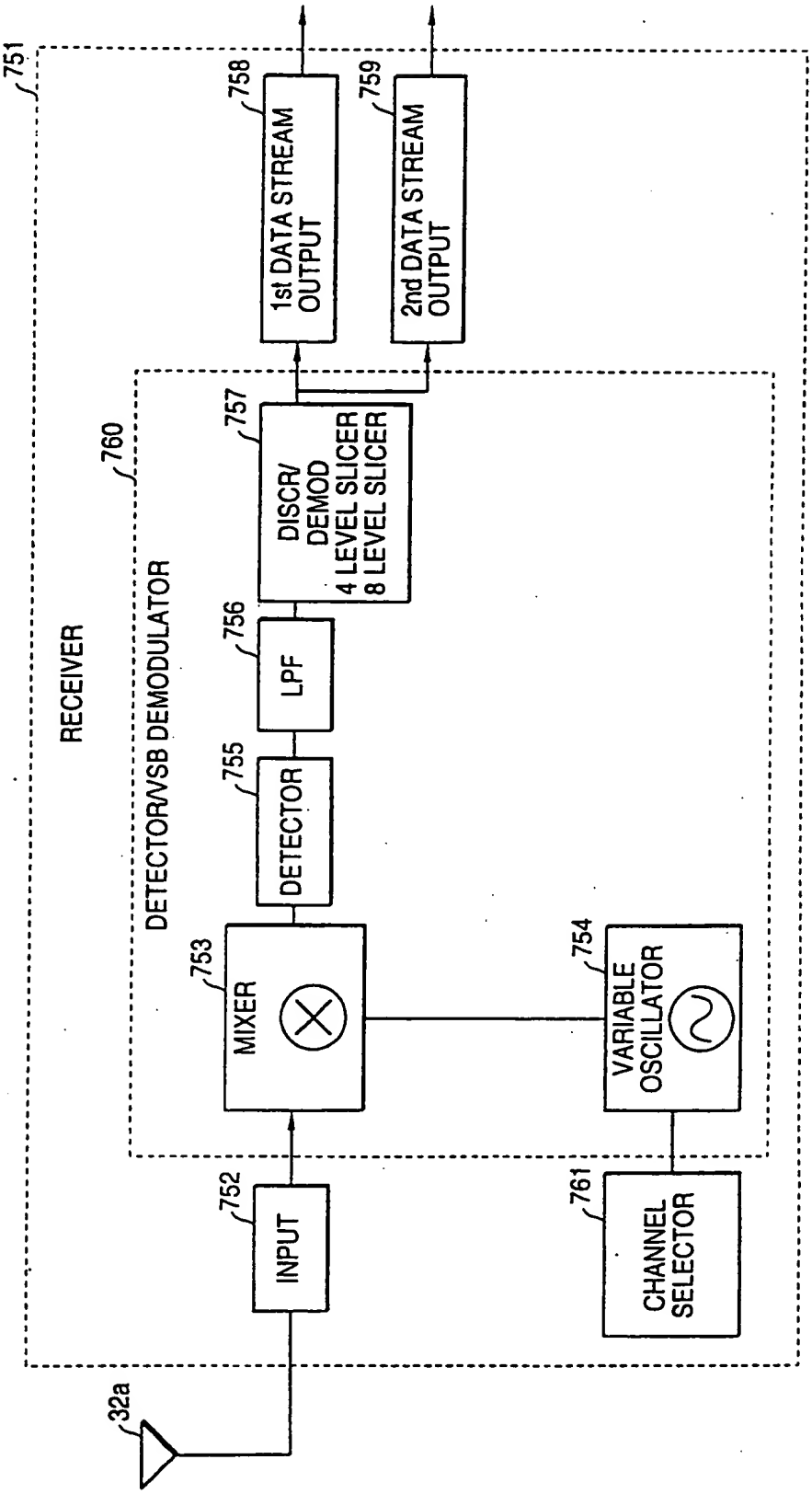


FIG. 62(b)

CHARACTERISTICS OF VSB FILTER

FIG. 63


751
RECEIVER
760
DETECTOR/VSB DEMODULATOR
758
1st DATA STREAM OUTPUT
759
2nd DATA STREAM OUTPUT
757
DISCR/ DEMOD 4 LEVEL SLICER 8 LEVEL SLICER
756
LPF
755
DETECTOR
753
MIXER
754
VARIABLE OSCILLATOR
752
INPUT
761
CHANNEL SELECTOR
32a

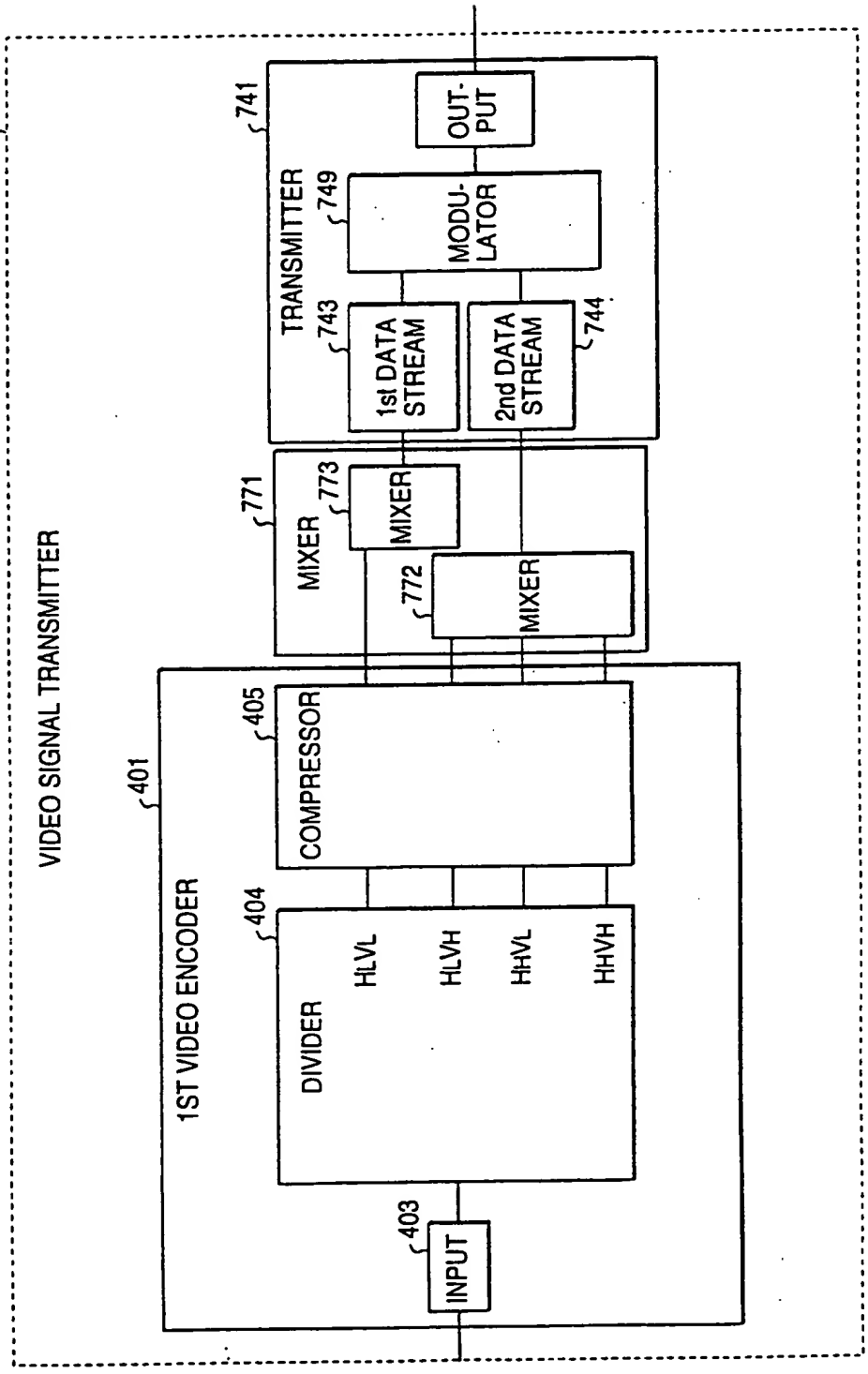

774
VIDEO SIGNAL TRANSMITTER
741
TRANSMITTER
OUT-PUT
749
MODU-LATOR
743
1st DATA STREAM
744
2nd DATA STREAM
771
MIXER
773
MIXER
772
MIXER
401
1ST VIDEO ENCODER
405
COMPRESSOR
404
DIVIDER
HLVL
HLVH
HHVL
HHVH
403
INPUT

FIG. 64

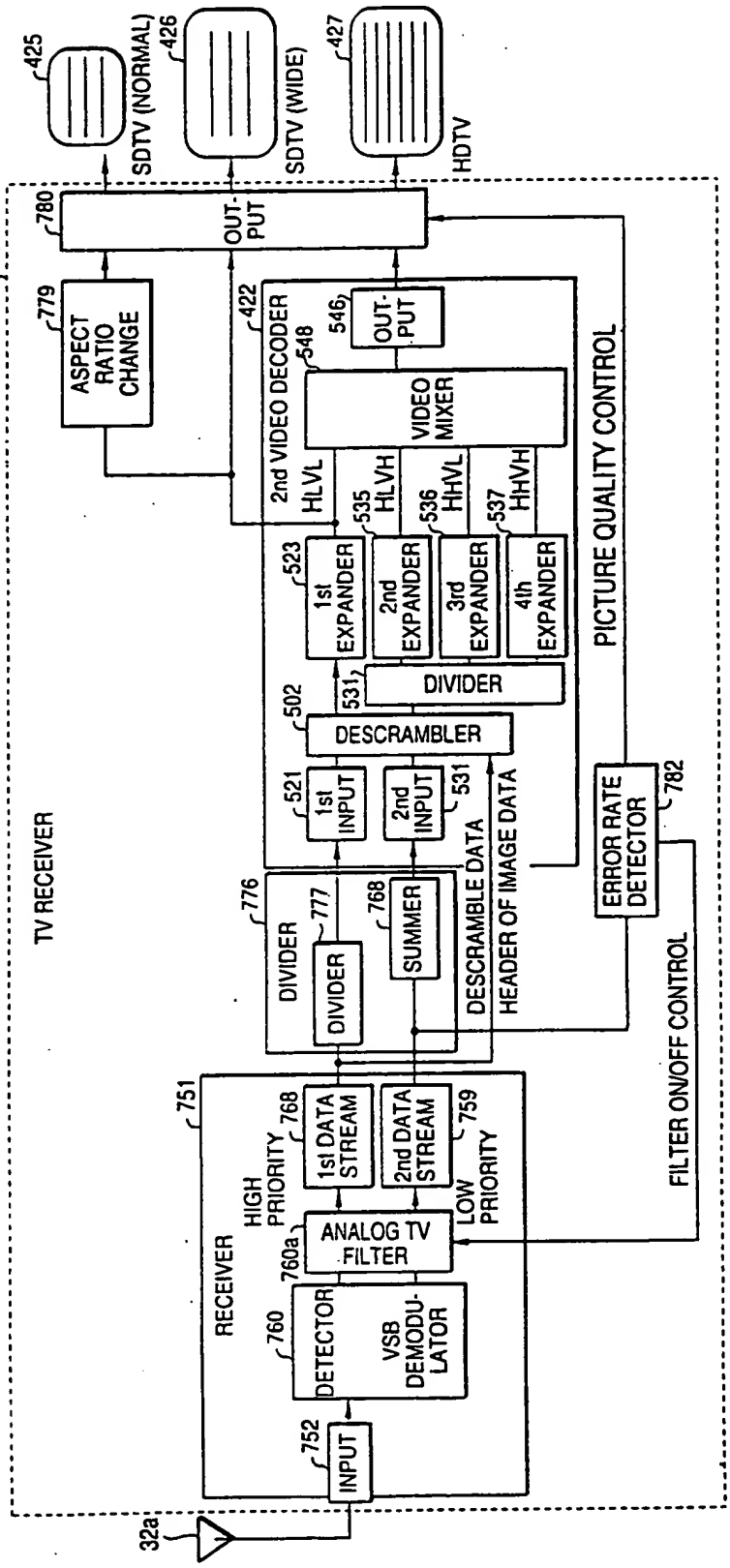

425
SDTV (NORMAL)
426
SDTV (WIDE)
427
HDTV
780
OUT-PUT
781
779
ASPECT RATIO CHANGE
422
2nd VIDEO DECODER
546
OUT-PUT
548
VIDEO MIXER
HLVL
535 HLVH
536 HHVL
537 HHVH
523
1st EXPANDER
2nd EXPANDER
3rd EXPANDER
4th EXPANDER
531
DIVIDER
502
DESCRAMBLER
521
1st INPUT
2nd INPUT
531
DESCRAMBLE DATA
HEADER OF IMAGE DATA
PICTURE QUALITY CONTROL
782
ERROR RATE DETECTOR
FILTER ON/OFF CONTROL
776
DIVIDER
777
DIVIDER
768
SUMMER
TV RECEIVER
751
RECEIVER
HIGH PRIORITY
768
1st DATA STREAM
2nd DATA STREAM
759
LOW PRIORITY
760a
ANALOG TV FILTER
760
DETECTOR
VSB DEMODU-LATOR
752
INPUT
32a

FIG. 65

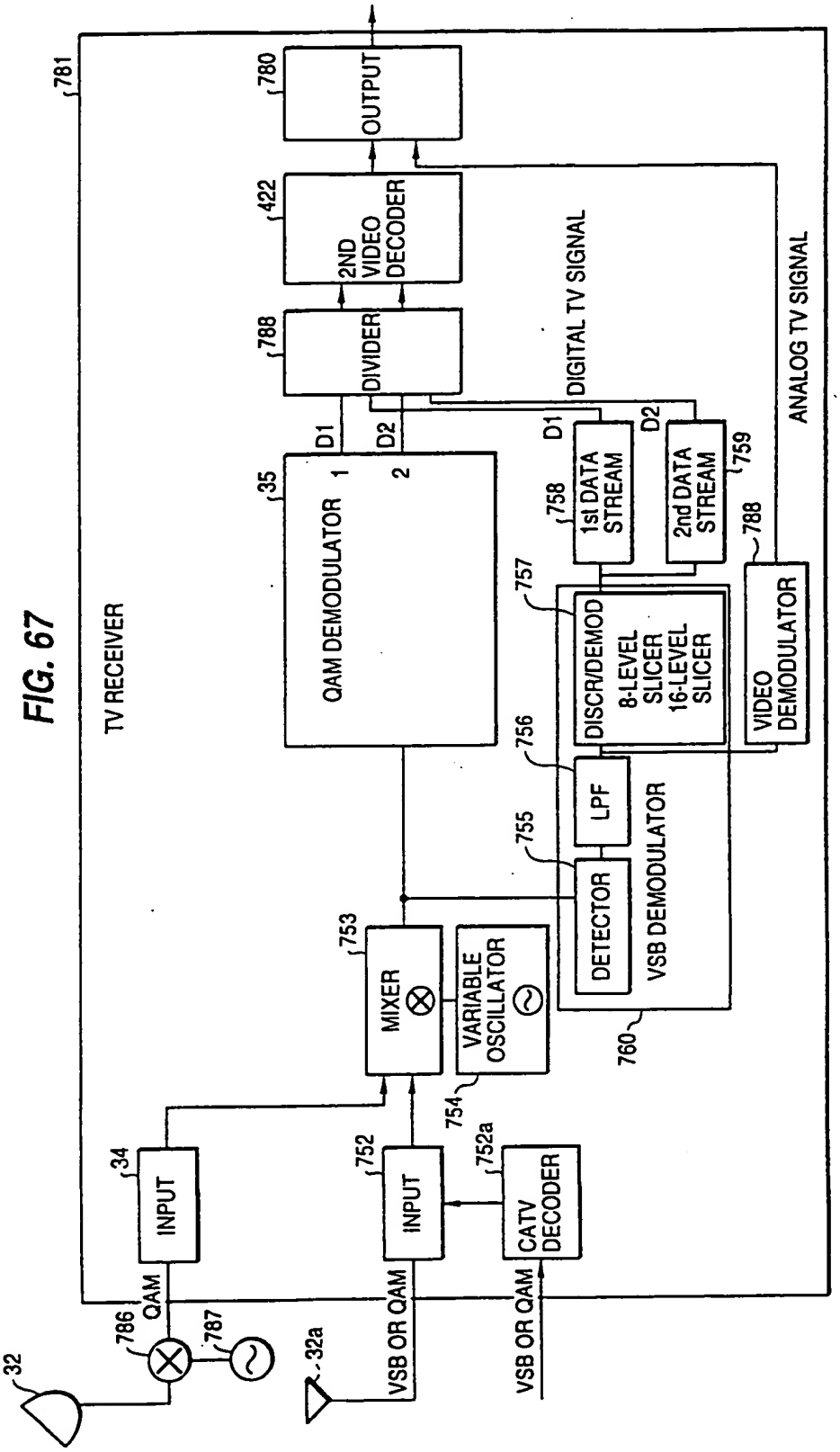

781
TV RECEIVER
780
OUTPUT
422
2ND VIDEO DECODER
788
DIVIDER
DIGITAL TV SIGNAL
ANALOG TV SIGNAL
D1
D2
35
QAM DEMODULATOR
1
2
758
1st DATA STREAM
759
2nd DATA STREAM
757
DISCR/DEMOD
8-LEVEL SLICER
16-LEVEL SLICER
VIDEO DEMODULATOR
756
LPF
755
DETECTOR
VSB DEMODULATOR
760
753
MIXER
VARIABLE OSCILLATOR
754
34
INPUT
752
INPUT
752a
CATV DECODER
QAM
VSB OR QAM
VSB OR QAM
786
787
32
32a

FIG. 67

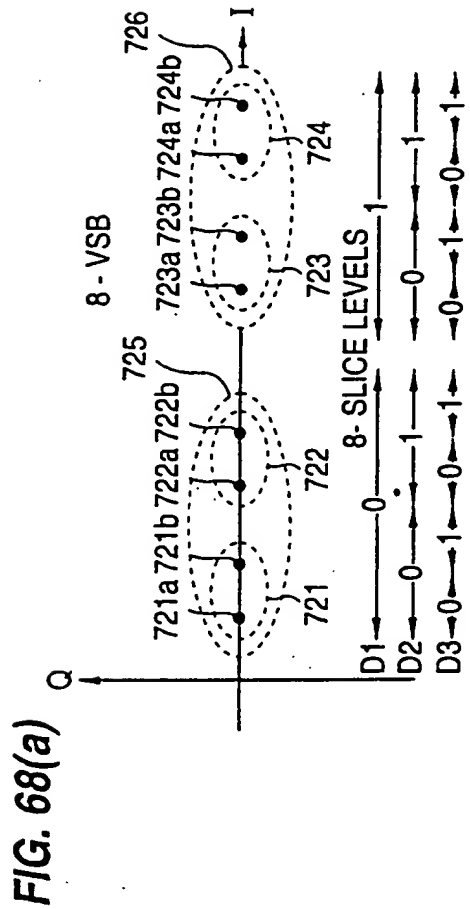


FIG. 68(a)

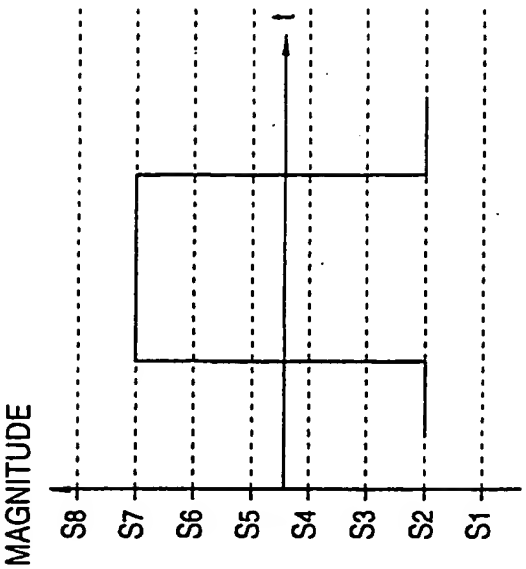


FIG. 68(c)

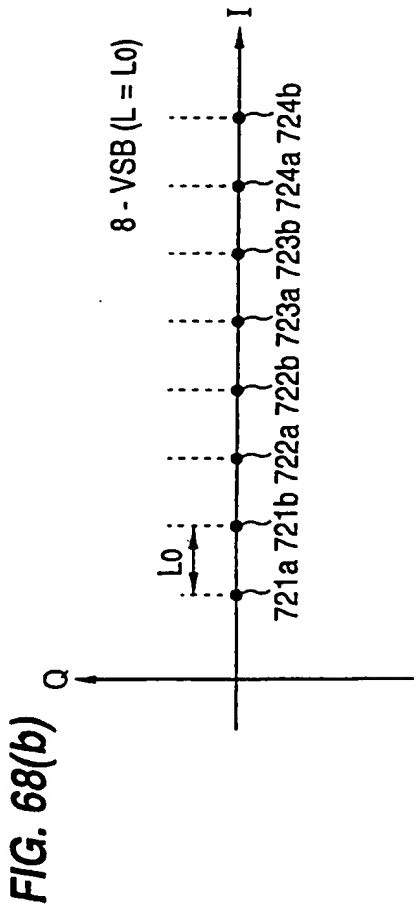


FIG. 68(b)

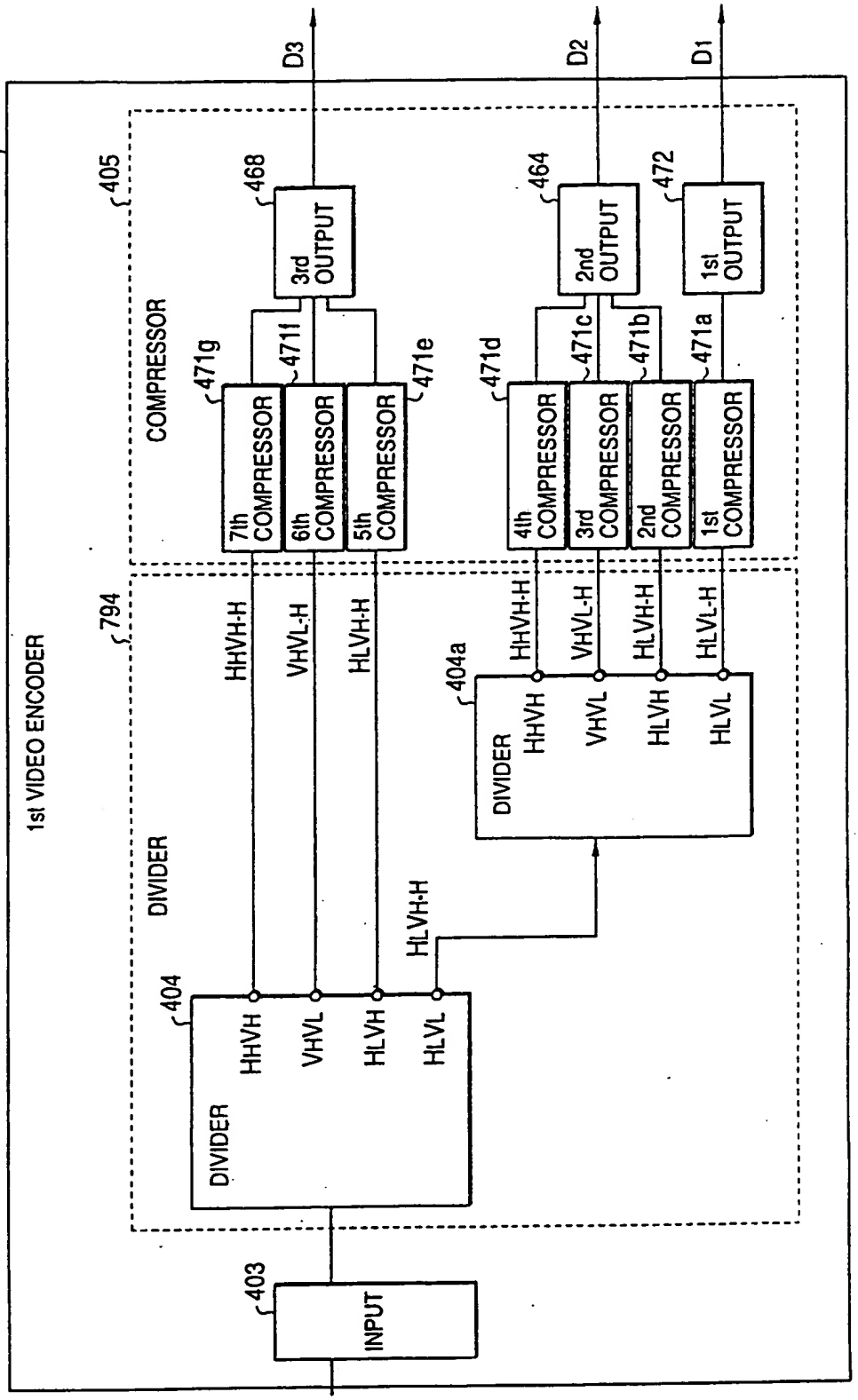

1st VIDEO ENCODER
401
INPUT
403
DIVIDER
404
HHVH
VHVL
HLVH
HLVL
794
DIVIDER
404a
HHVH
VHVL
HLVH
HLVL
HHVH-H
VHVL-H
HLVH-H
HLVL-H
COMPRESSOR
405
7th COMPRESSOR
6th COMPRESSOR
5th COMPRESSOR
4th COMPRESSOR
3rd COMPRESSOR
2nd COMPRESSOR
1st COMPRESSOR
471g
4711
471e
471d
471c
471b
471a
3rd OUTPUT
2nd OUTPUT
1st OUTPUT
468
464
472
D3
D2
D1

FIG. 69

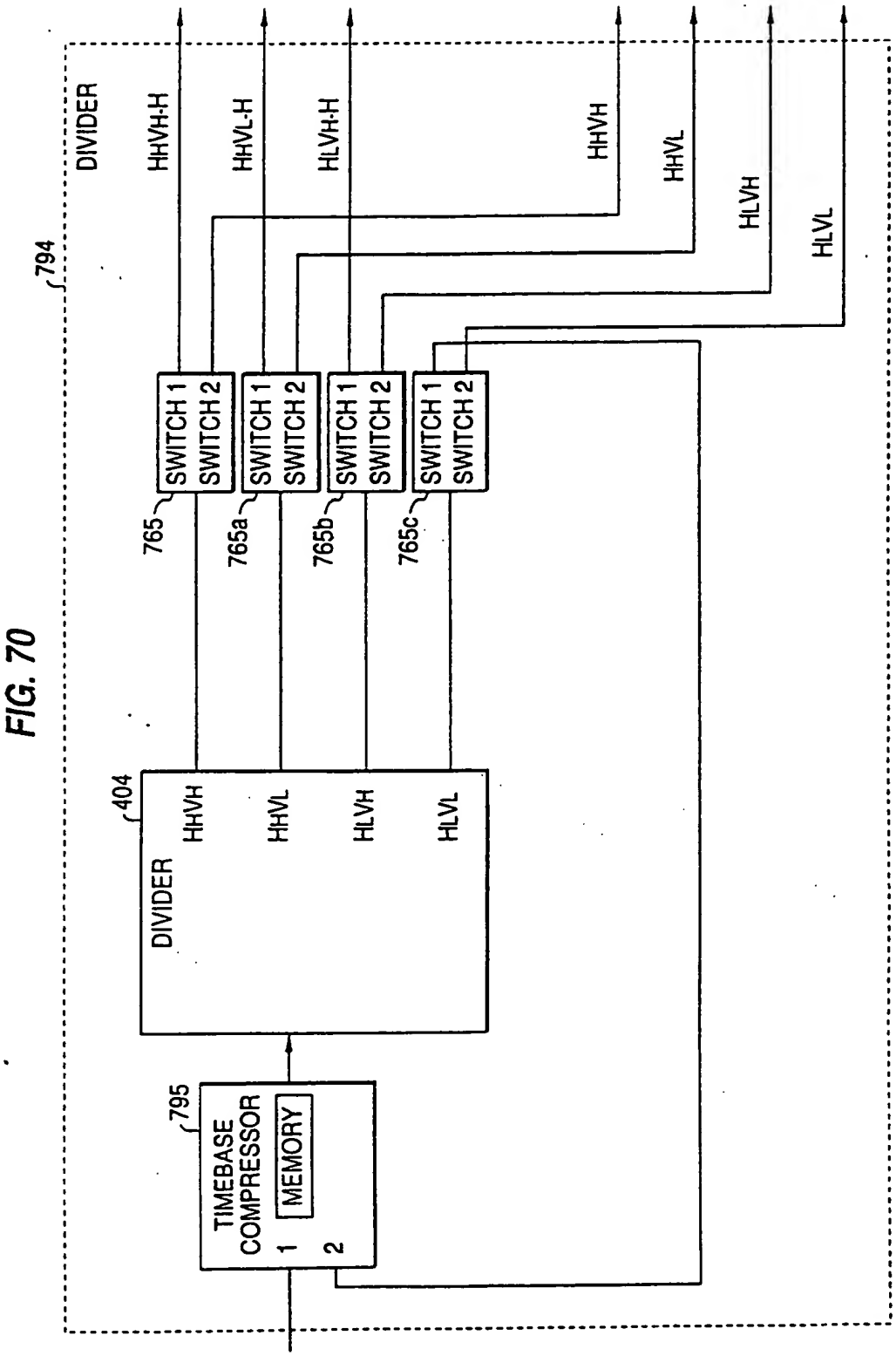
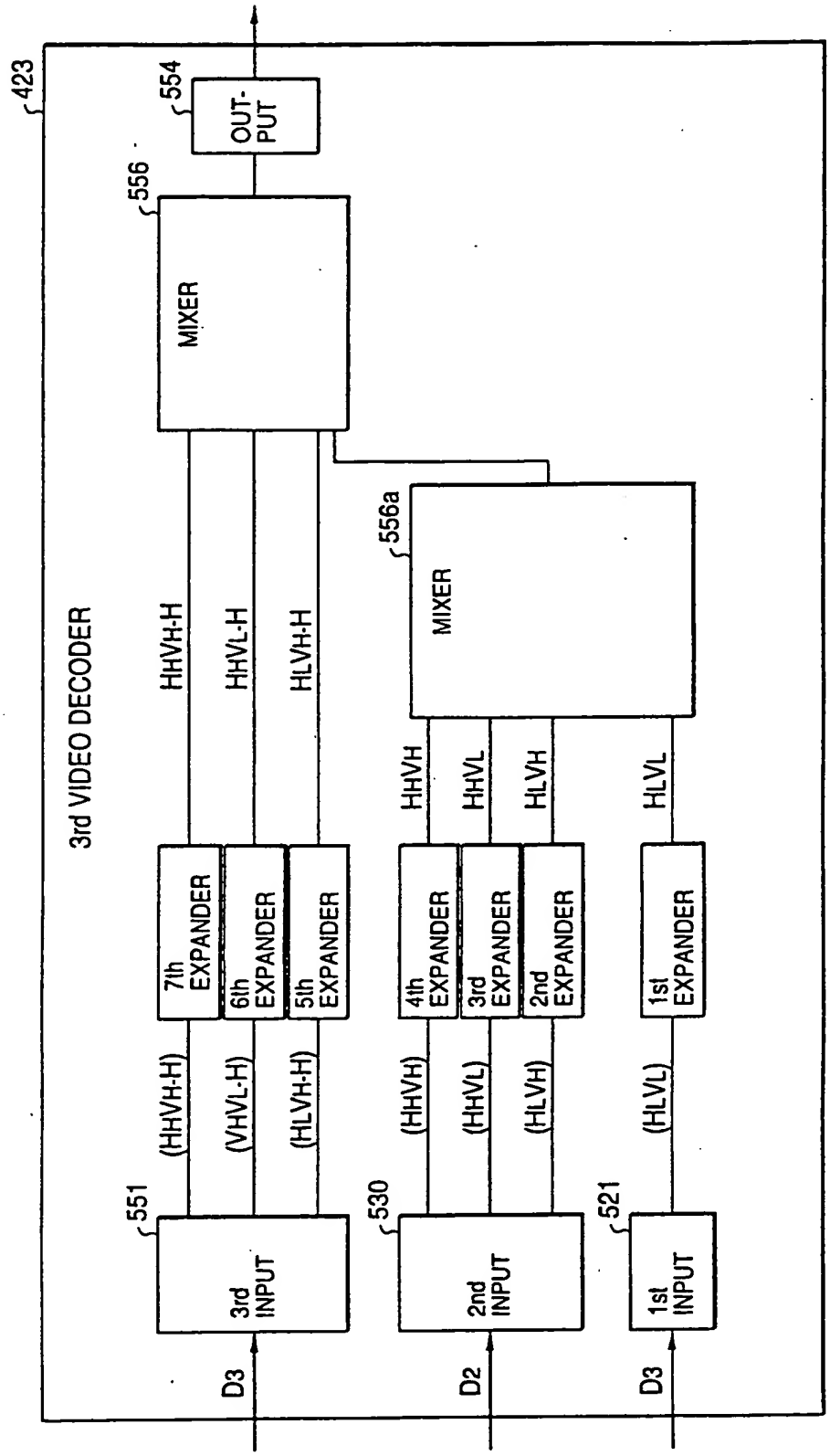

794
DIVIDER
HHVH-H
HHVL-H
HLVH-H
HHVH
HHVL
HLVH
HLVL
765
765a
765b
765c
SWITCH 1
SWITCH 2
404
DIVIDER
HHVH
HHVL
HLVH
HLVL
795
TIMEBASE COMPRESSOR
MEMORY
1
2

FIG. 70

FIG. 71


423
3rd VIDEO DECODER
554
OUT-PUT
556
MIXER
556a
MIXER
HHVH-H
HHVL-H
HLVH-H
HHVH
HHVL
HLVH
HLVL
7th EXPANDER
6th EXPANDER
5th EXPANDER
4th EXPANDER
3rd EXPANDER
2nd EXPANDER
1st EXPANDER
(HHVH-H)
(VHVL-H)
(HLVH-H)
(HHVH)
(HHVL)
(HLVH)
(HLVL)
551
530
521
3rd INPUT
2nd INPUT
1st INPUT
D3
D2
D3

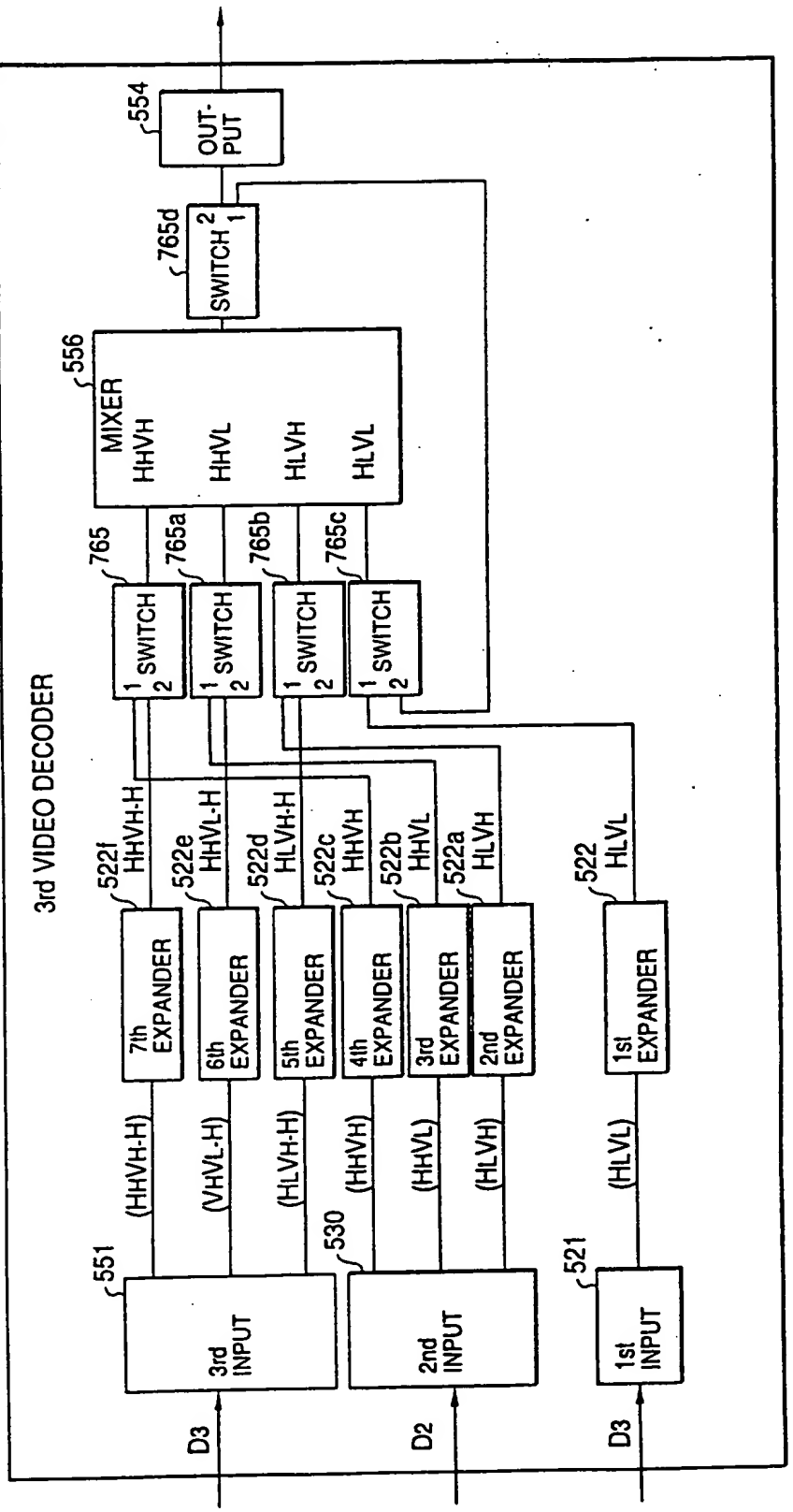

423
3rd VIDEO DECODER
554
OUT-PUT
765d
SWITCH
556
MIXER
HHVH
HHVL
HLVH
HLVL
765
765a
765b
765c
SWITCH
522f HHVH-H
522e HHVL-H
522d HLVH-H
522c HHVH
522b HHVL
522a HLVH
522 HLVL
7th EXPANDER
6th EXPANDER
5th EXPANDER
4th EXPANDER
3rd EXPANDER
2nd EXPANDER
1st EXPANDER
(HHVH-H)
(VHVL-H)
(HLVH-H)
(HHVH)
(HHVL)
(HLVH)
(HLVL)
551
530
521
3rd INPUT
2nd INPUT
1st INPUT
D3
D2
D3

FIG. 72

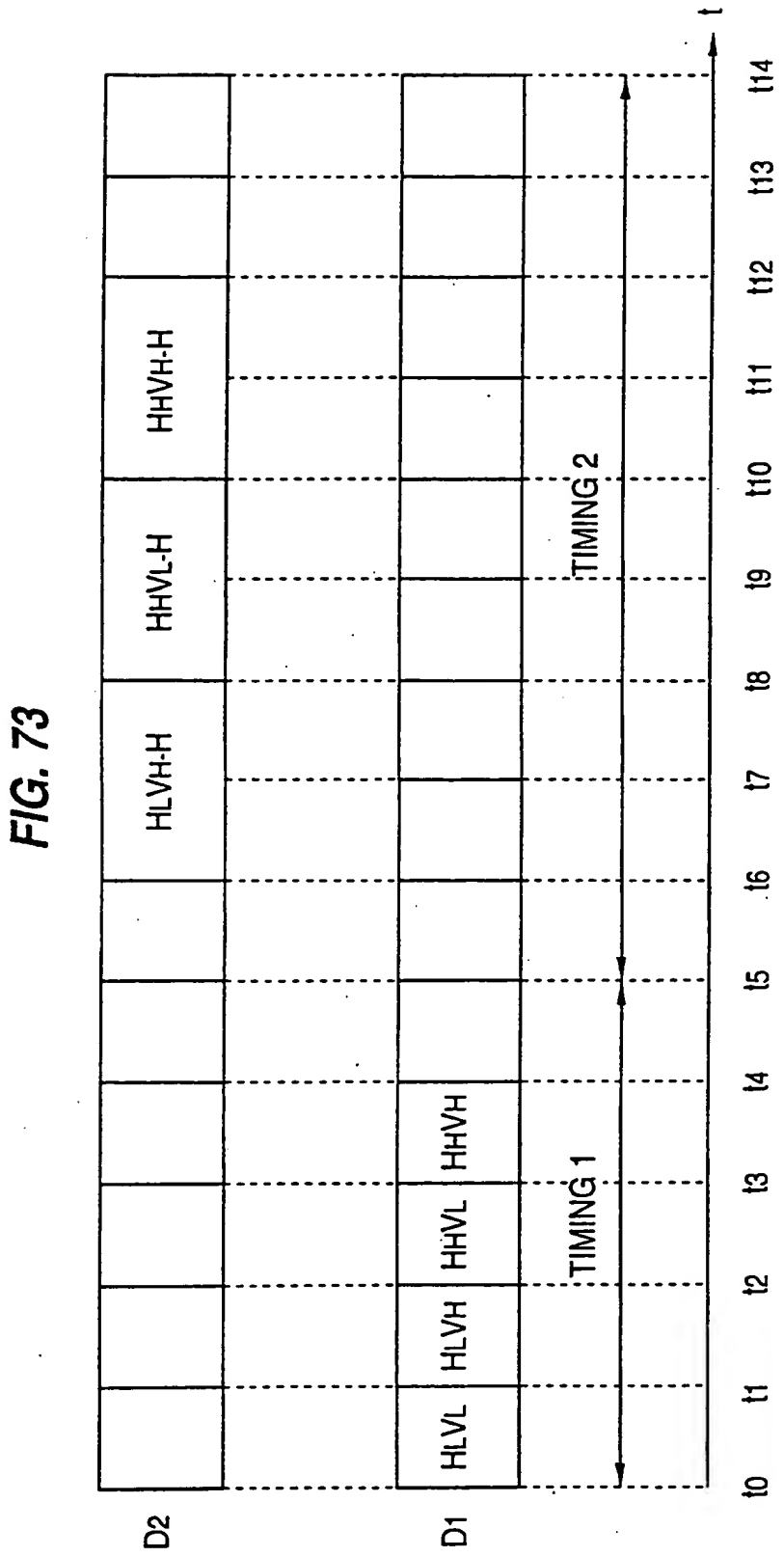

t
t14
t13
t12
t11
t10
t9
t8
t7
t6
t5
t4
t3
t2
t1
t0
HHVH-H
HHVL-H
HLVH-H
TIMING 2
HHVH
HHVL
HLVH
HLVL
TIMING 1
D2
D1

FIG. 73

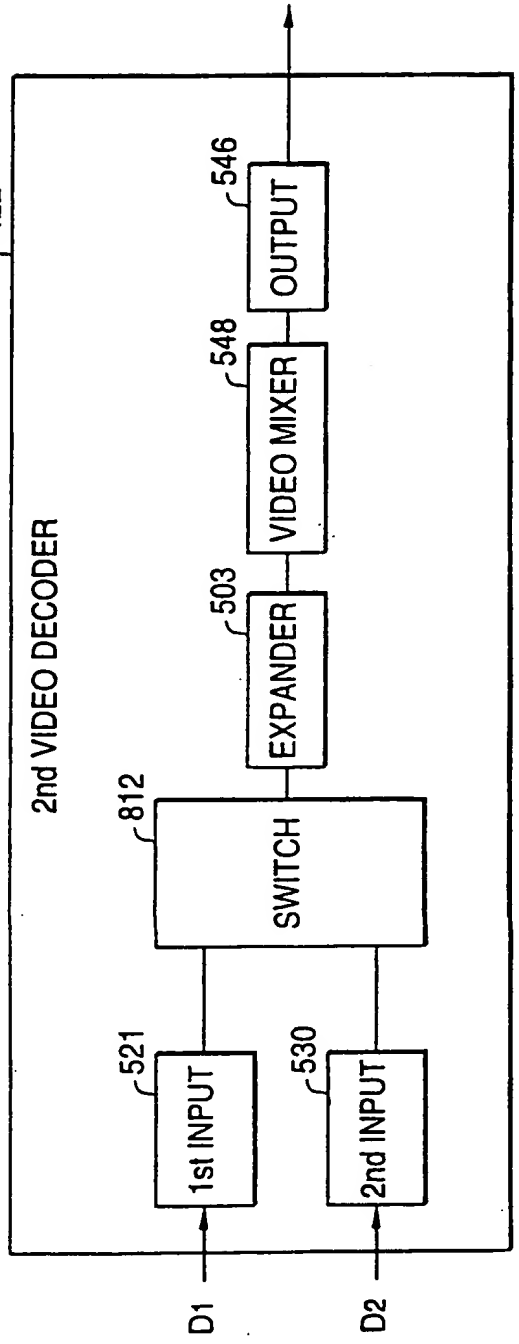


FIG. 74(a)

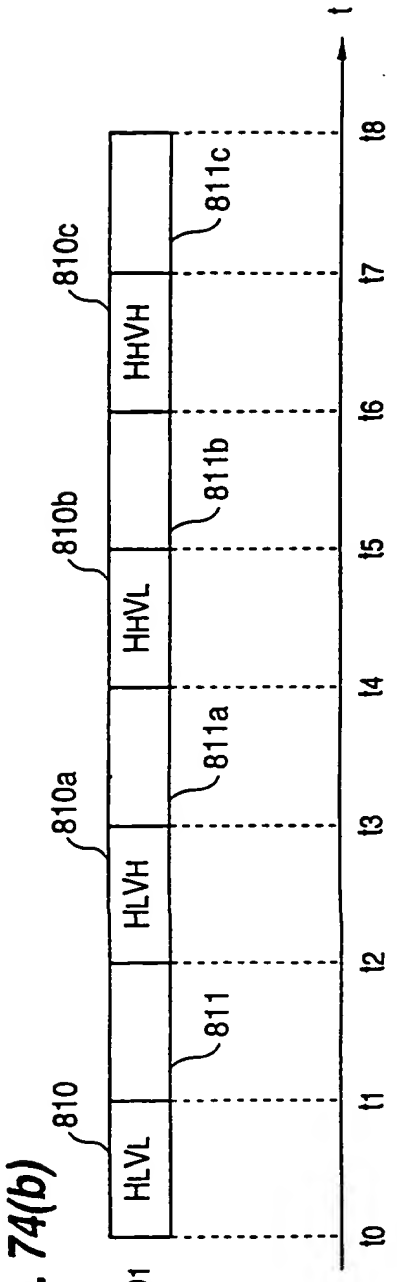


FIG. 74(b)

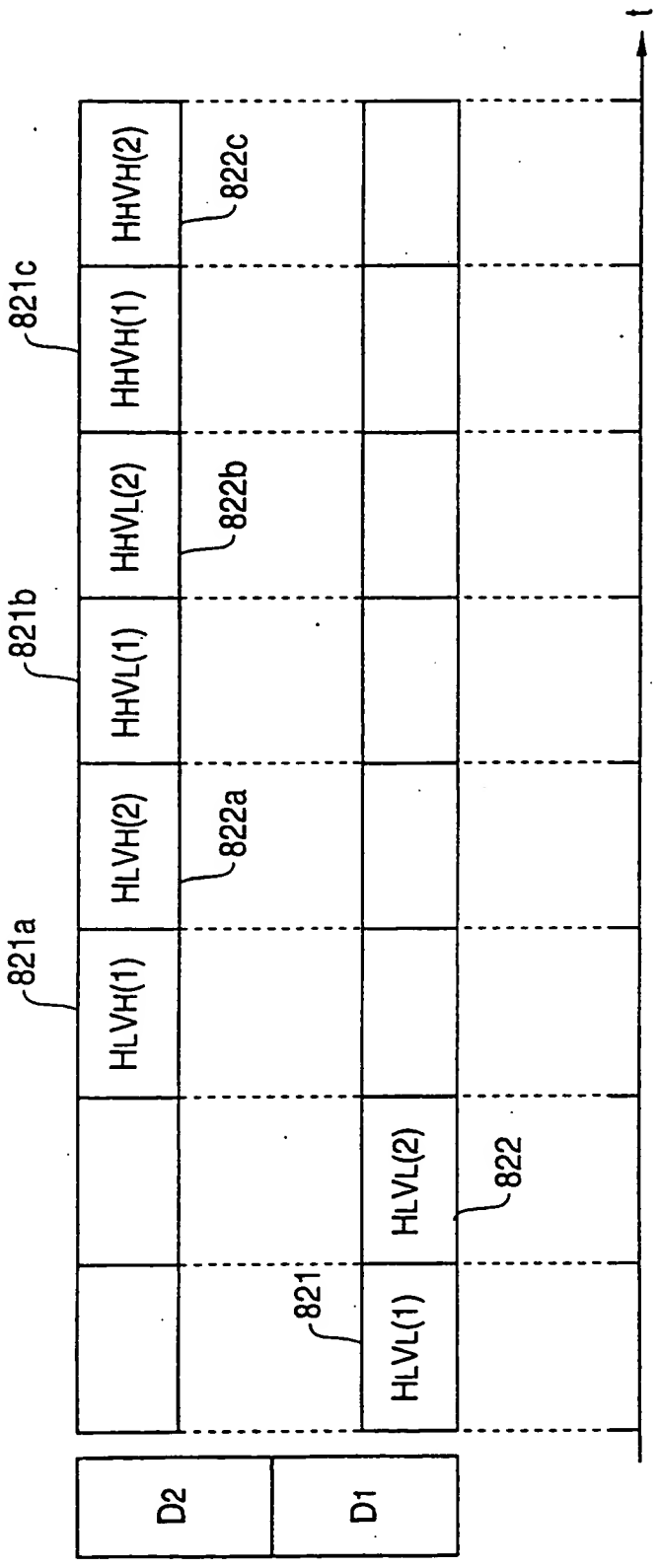

t
D2
D1
HLVL(1)
HLVL(2)
HLVH(1)
HLVH(2)
HHVL(1)
HHVL(2)
HHVH(1)
HHVH(2)
821
822
821a
821b
821c
822a
822b
822c

FIG. 75

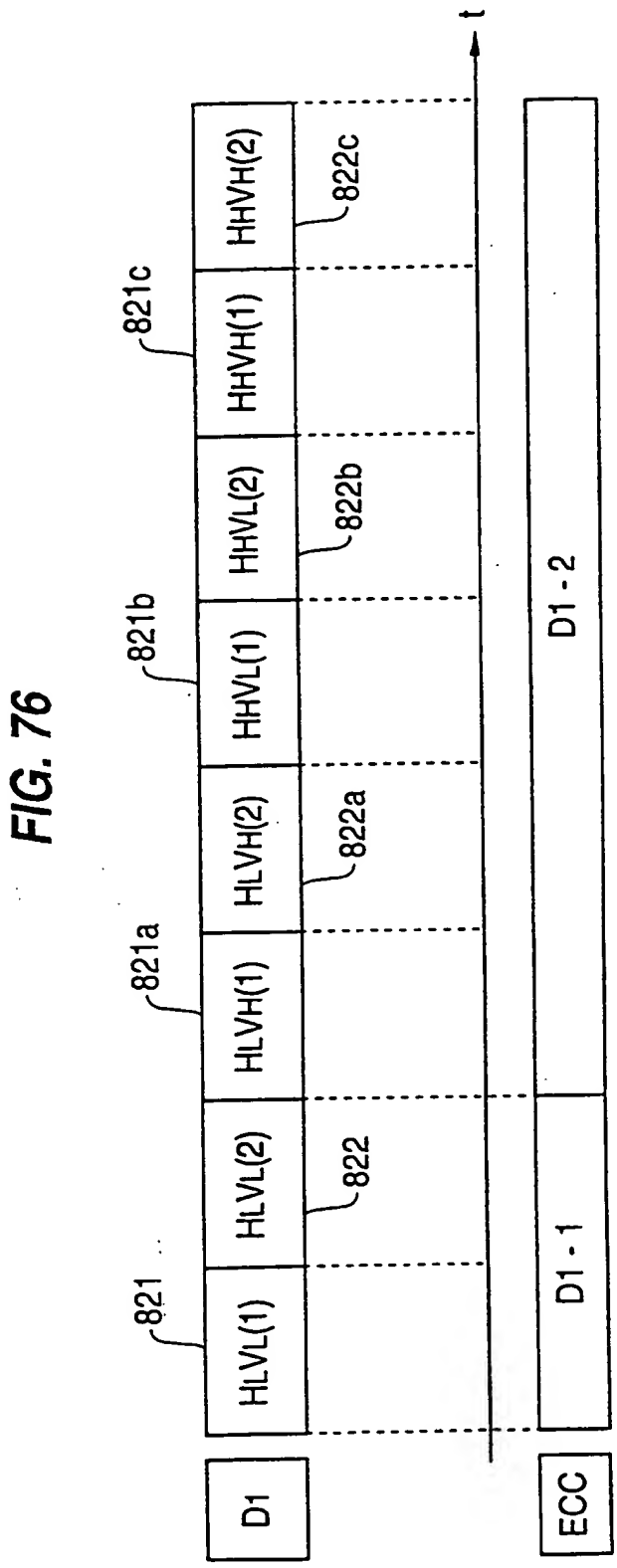

t
D1
ECC
HLVL(1)
HLVL(2)
HLVH(1)
HLVH(2)
HHVL(1)
HHVL(2)
HHVH(1)
HHVH(2)
D1 - 1
D1 - 2
821
821a
821b
821c
822
822a
822b
822c

FIG. 76

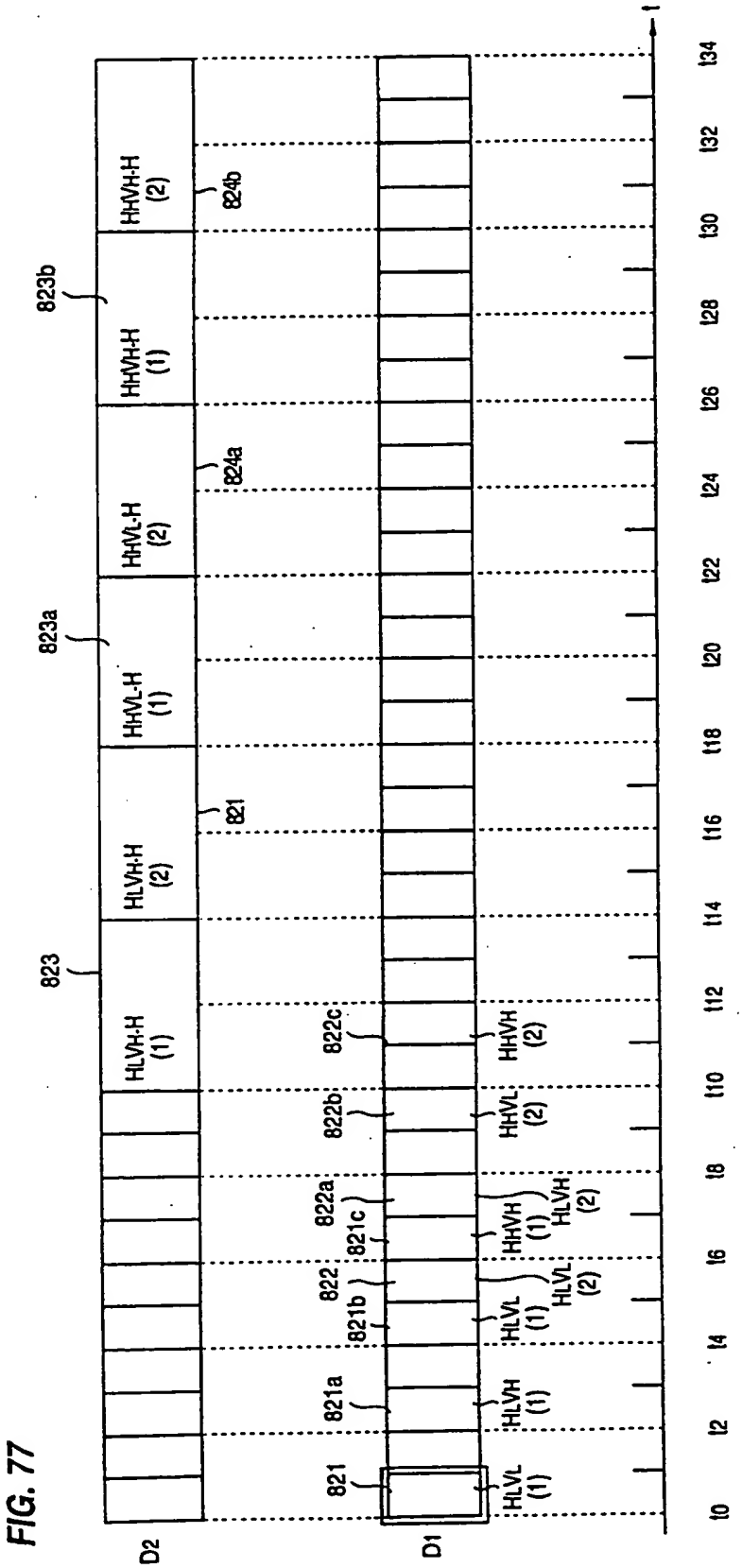

t
t0
t2
t4
t6
t8
t10
t12
t14
t16
t18
t20
t22
t24
t26
t28
t30
t32
t34
D1
D2
821
821a
822
821b
822a
821c
822b
822c
823
823a
823b
824a
824b
HLVL (1)
HLVH (1)
HLVL (2)
HLVH (2)
HHVL (1)
HHVH (1)
HHVL (2)
HHVH (2)

FIG. 77

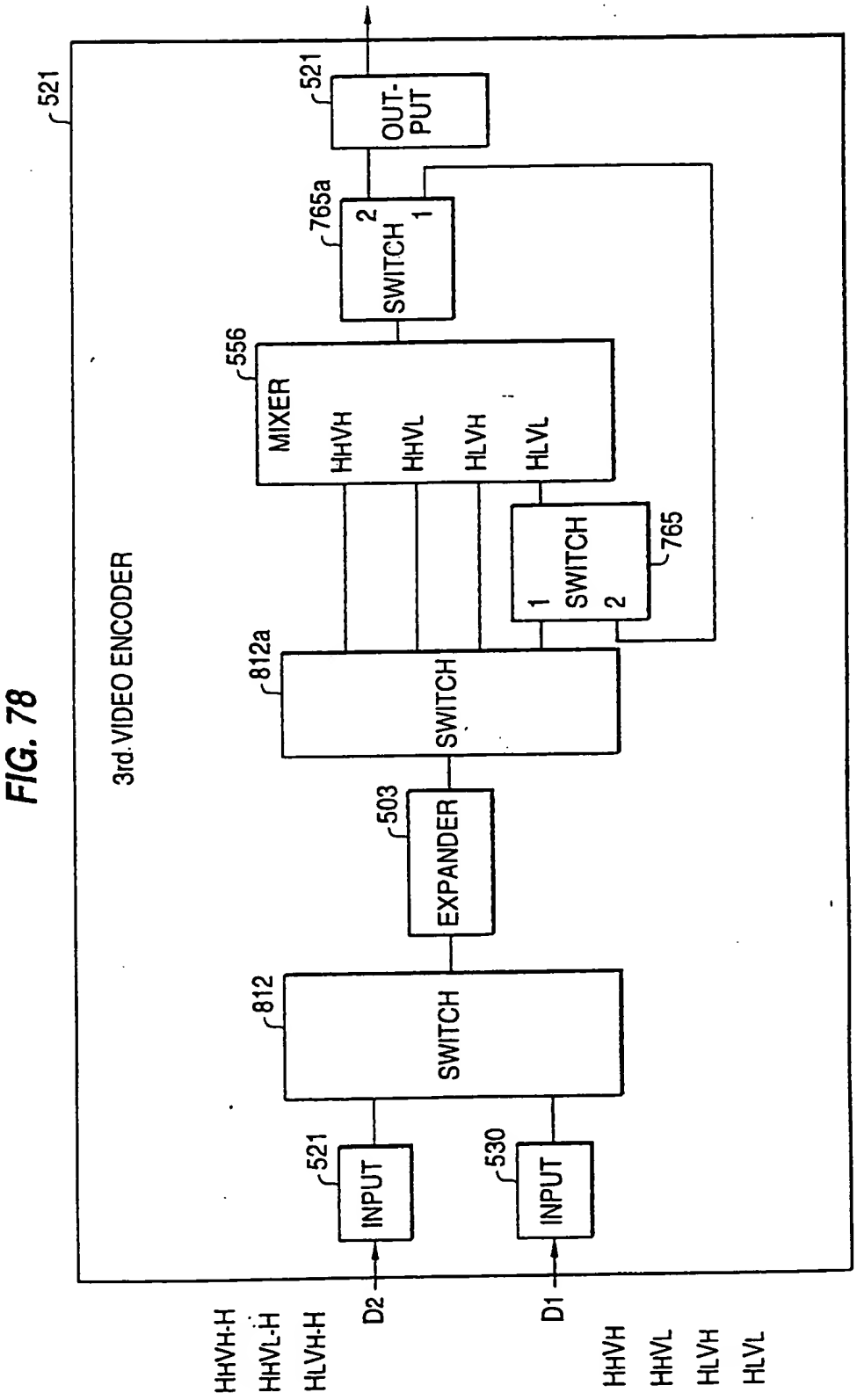

521
3rd. VIDEO ENCODER
521
OUT-PUT
765a
SWITCH
2
1
556
MIXER
HHVH
HHVL
HLVH
HLVL
765
SWITCH
1
2
812a
SWITCH
503
EXPANDER
812
SWITCH
521
INPUT
530
INPUT
D2
D1
HHVH-H
HHVL-H
HLVH-H
HHVH
HHVL
HLVH
HLVL

FIG. 78

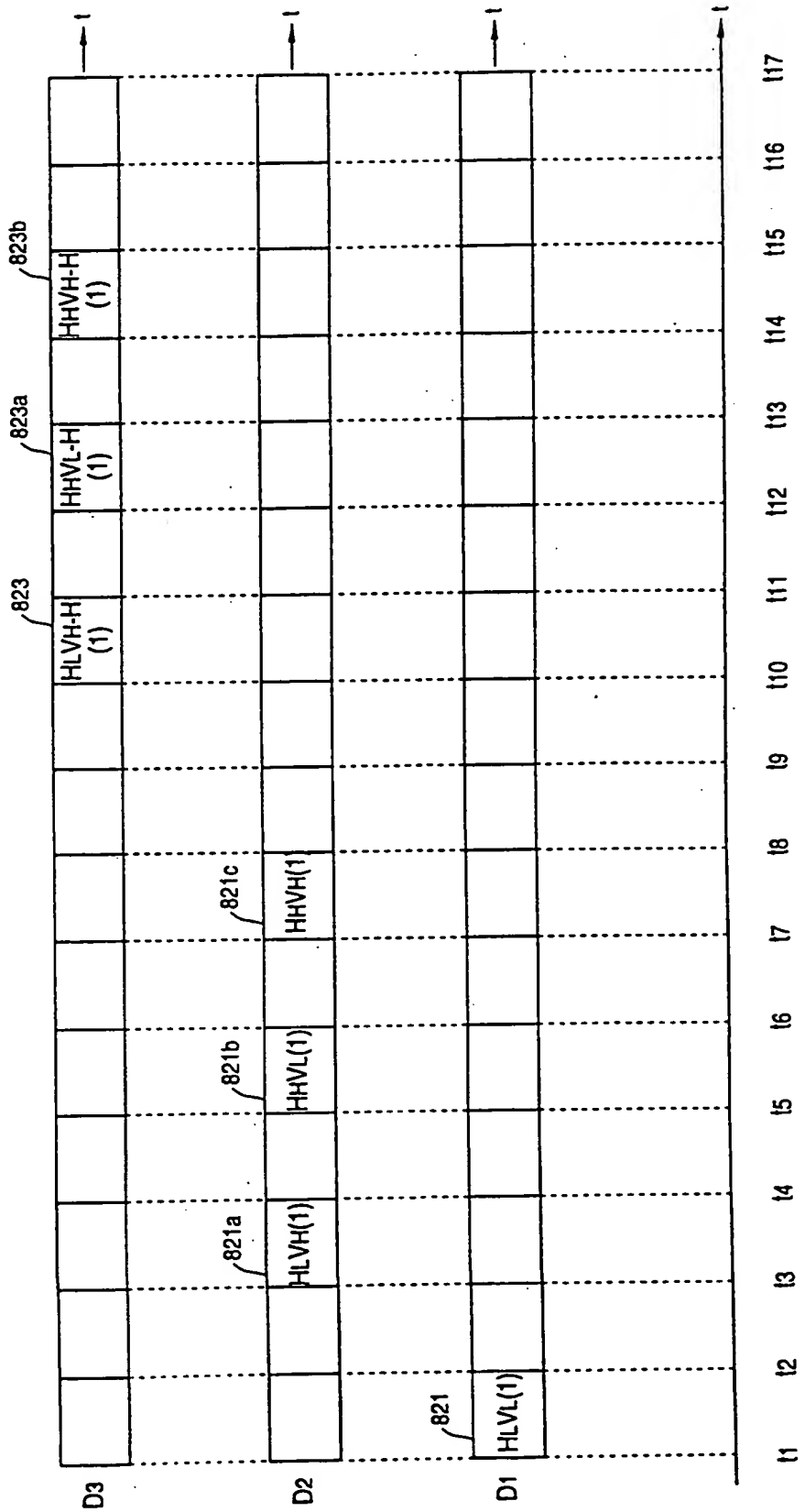

t1
t2
t3
t4
t5
t6
t7
t8
t9
t10
t11
t12
t13
t14
t15
t16
t17
D3
D2
D1
HLVH-H (1)
823
HHVL-H (1)
823a
HHVH-H (1)
823b
HLVH(1)
821a
HHVL(1)
821b
HHVH(1)
821c
HLVL(1)
821

FIG. 79

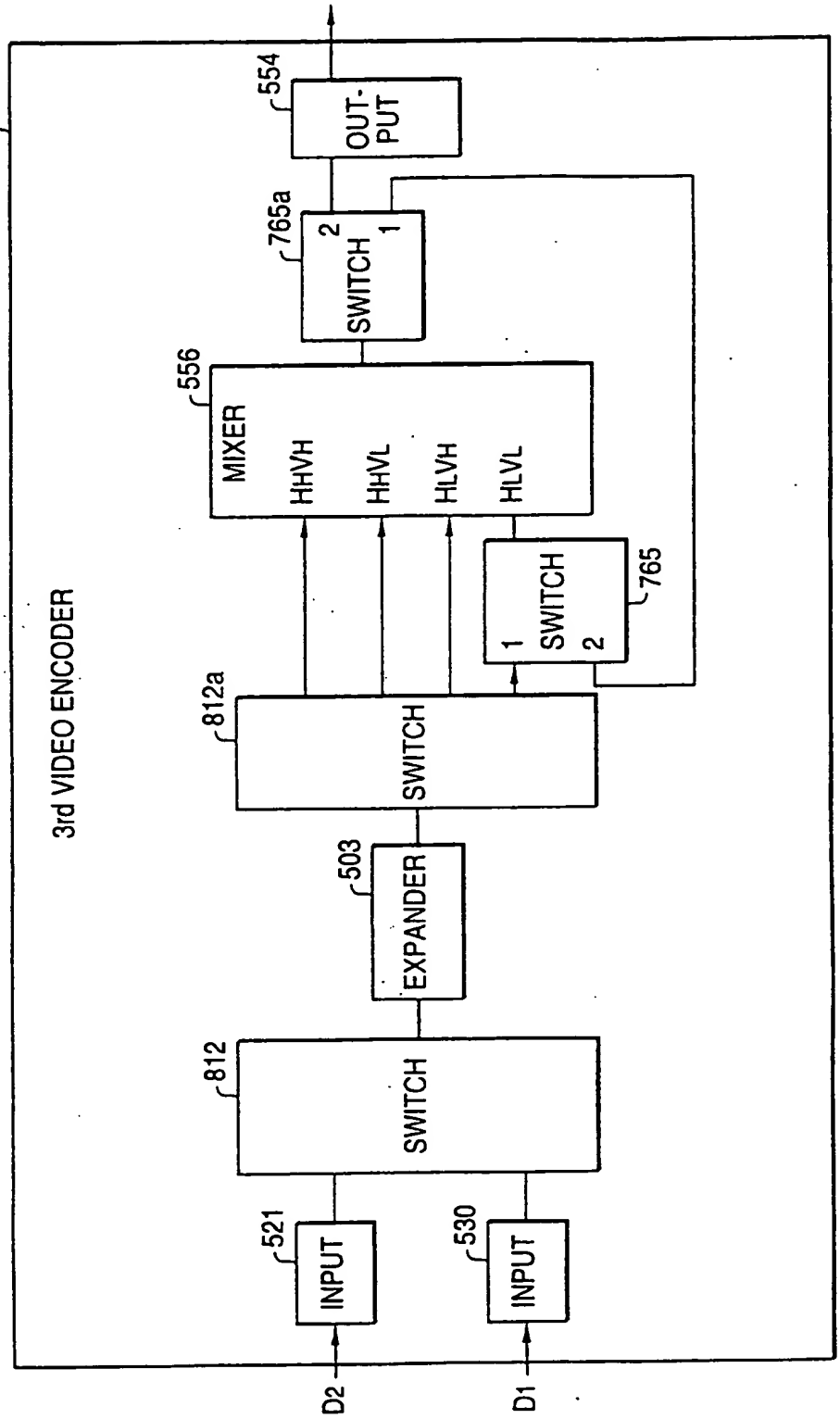

423
3rd VIDEO ENCODER
554
OUT-PUT
765a
SWITCH
2
1
556
MIXER
HHVH
HHVL
HLVH
HLVL
765
SWITCH
1
2
812a
SWITCH
503
EXPANDER
812
SWITCH
521
INPUT
530
INPUT
D2
D1

FIG. 80

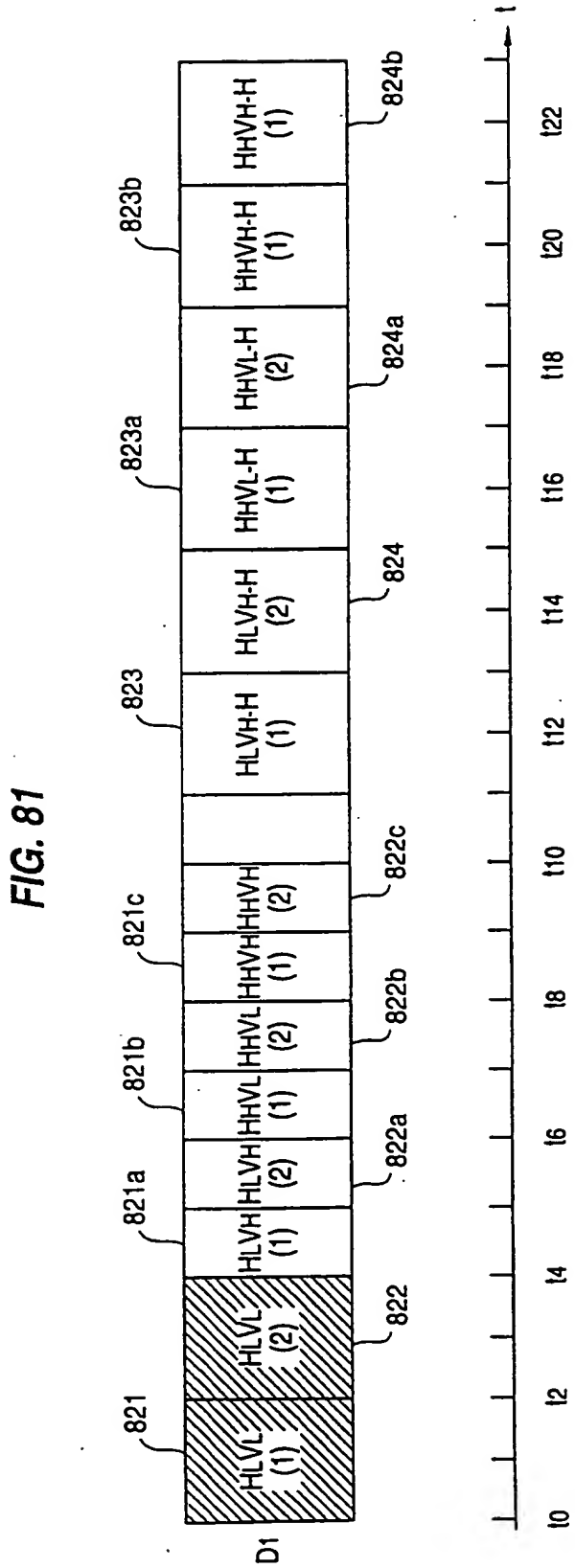

D1
821
HLVL (1)
HLVL (2)
822
821a
HLVH (1)
HLVH (2)
822a
821b
HHVL (1)
HHVL (2)
822b
821c
HHVH (1)
HHVH (2)
822c
823
HLVH-H (1)
HLVH-H (2)
824
823a
HHVL-H (1)
HHVL-H (2)
824a
823b
HHVH-H (1)
HHVH-H (1)
824b
t0
t2
t4
t6
t8
t10
t12
t14
t16
t18
t20
t22
t

FIG. 81

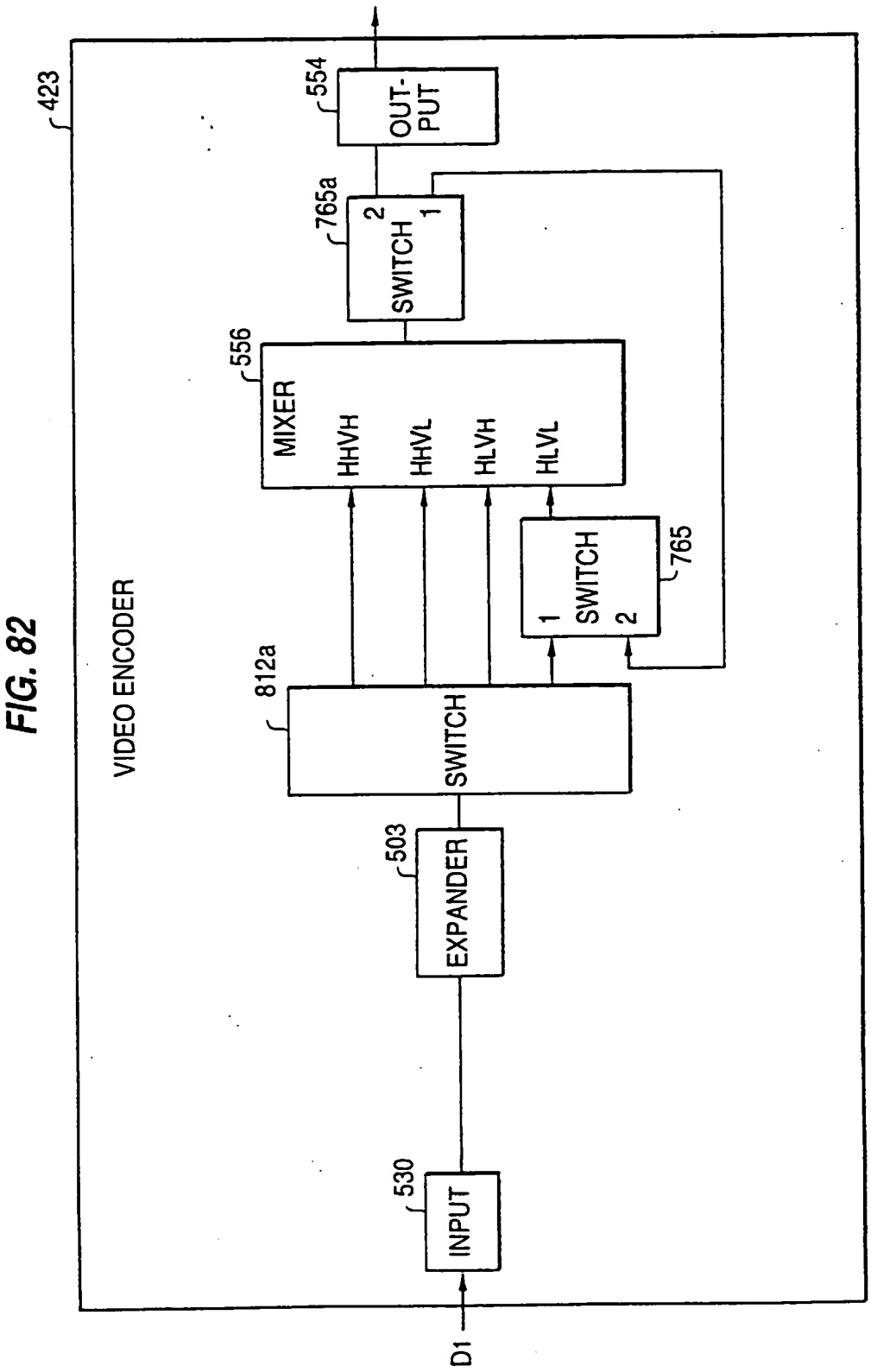
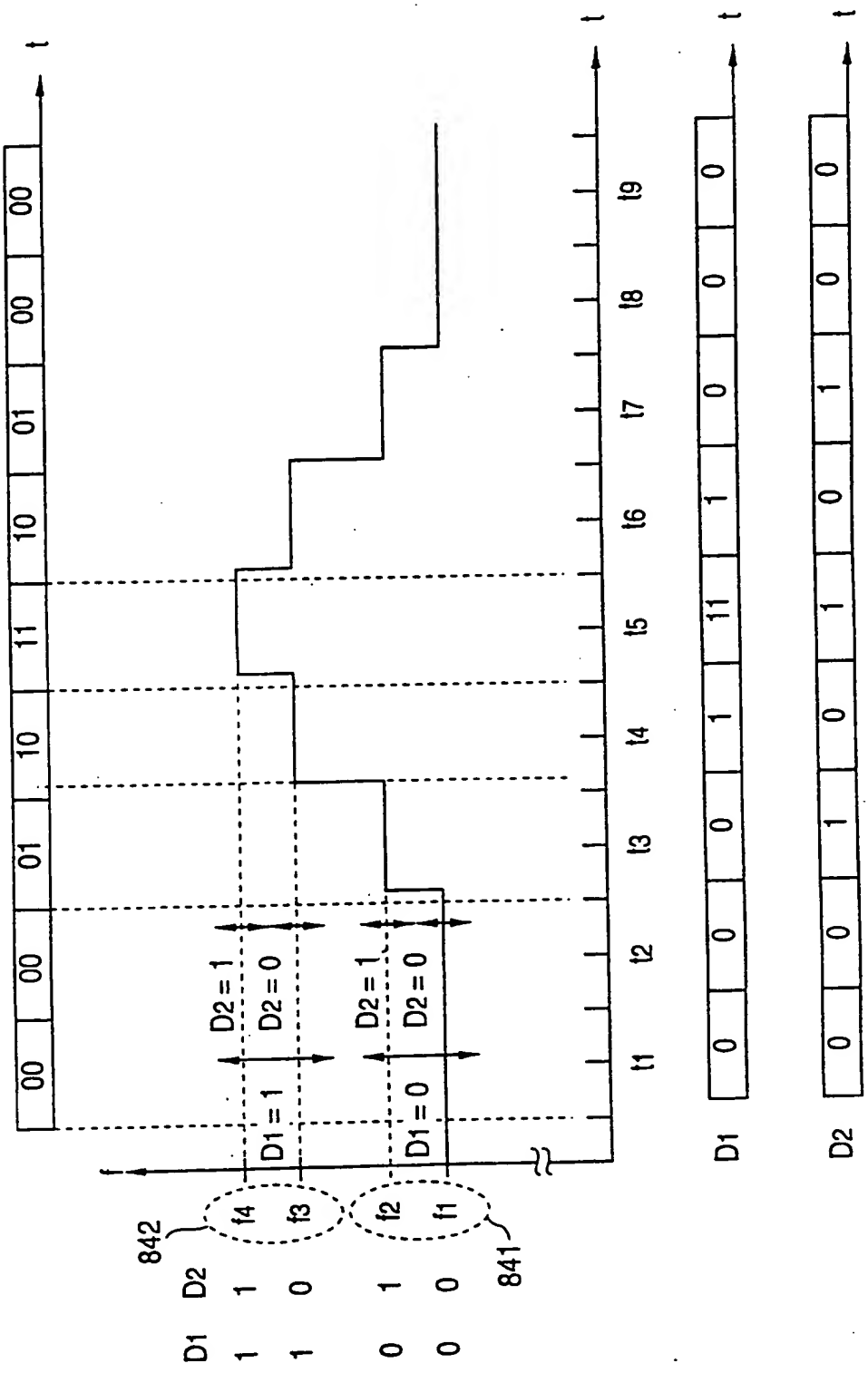

423
VIDEO ENCODER
554
OUT-PUT
765a
SWITCH
2
1
556
MIXER
HHVH
HHVL
HLVH
HLVL
765
SWITCH
1
2
812a
SWITCH
503
EXPANDER
530
INPUT
D1

FIG. 82

FIG. 83


t
00
00
01
10
11
10
01
00
00
D2 = 1
D2 = 0
D2 = 1
D2 = 0
D1 = 1
D1 = 0
t1
t2
t3
t4
t5
t6
t7
t8
t9
842
841
f4
f3
f2
f1
D2
D1
1 1 0 1 0 0
1 1 0 0
D1
D2
0 0 0 0 1 1 1 1 0 0 0 0
0 0 0 1 1 0 0 1 1 0 0 0

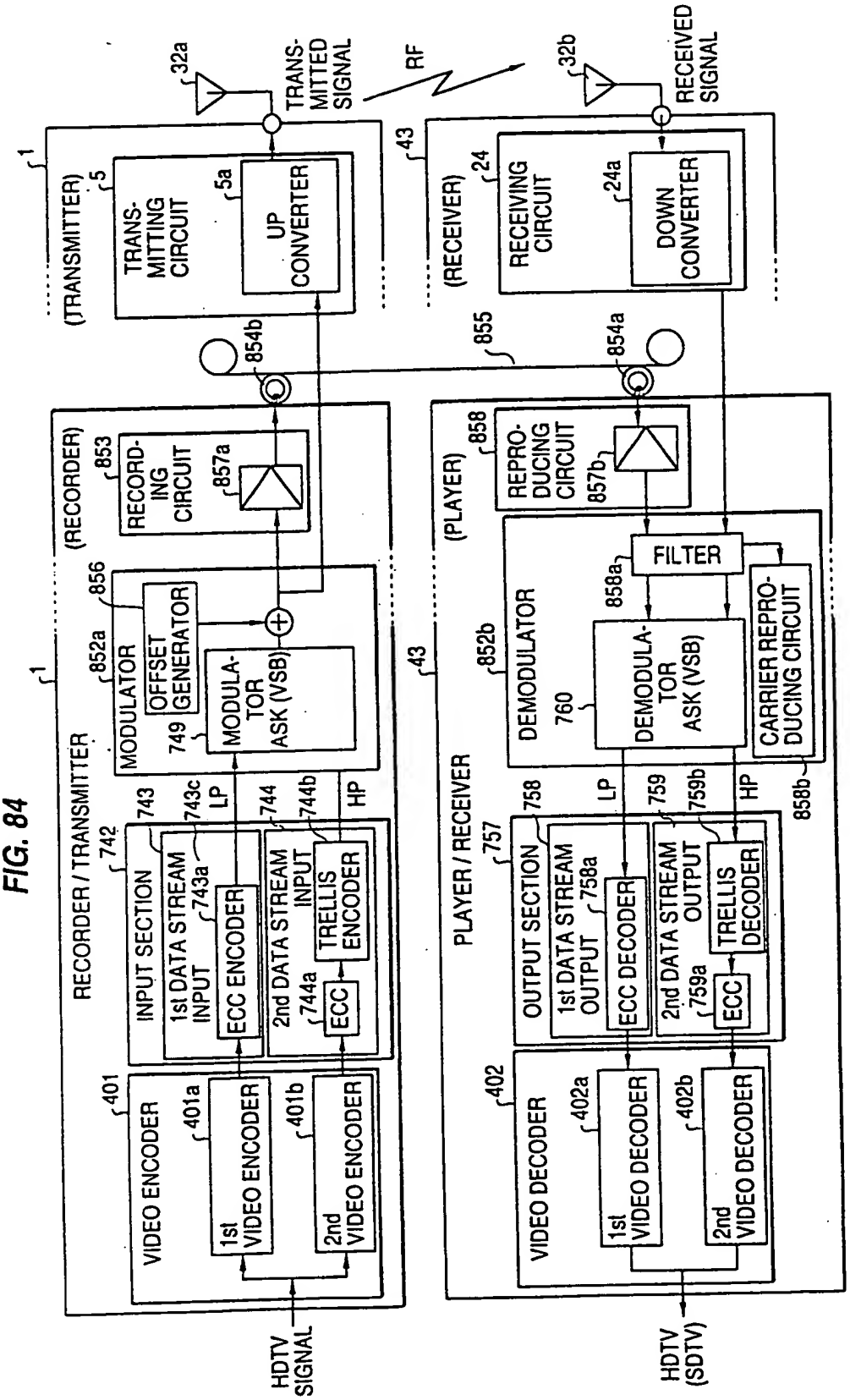

32a
TRANS-MITTED SIGNAL
RF
32b
RECEIVED SIGNAL
1
(TRANSMITTER)
5
TRANS-MITTING CIRCUIT
5a
UP CONVERTER
43
(RECEIVER)
24
RECEIVING CIRCUIT
24a
DOWN CONVERTER
854b
855
854a
(RECORDER)
853
RECORD-ING CIRCUIT
857a
(PLAYER)
858
REPRO-DUCING CIRCUIT
857b
856
852a
MODULATOR
OFFSET GENERATOR
749
MODULA-TOR ASK (VSB)
852b
DEMODULATOR
760
DEMODULA-TOR ASK (VSB)
858a
FILTER
CARRIER REPRO-DUCING CIRCUIT
RECORDER / TRANSMITTER
PLAYER / RECEIVER
743
743c
LP
744
744b
HP
758
759
759b
858b
742
INPUT SECTION
1st DATA STREAM INPUT
743a
ECC ENCODER
2nd DATA STREAM INPUT
744a
ECC
TRELLIS ENCODER
757
OUTPUT SECTION
1st DATA STREAM OUTPUT
758a
ECC DECODER
2nd DATA STREAM OUTPUT
759a
ECC
TRELLIS DECODER
401
VIDEO ENCODER
401a
1st VIDEO ENCODER
401b
2nd VIDEO ENCODER
402
VIDEO DECODER
402a
1st VIDEO DECODER
402b
2nd VIDEO DECODER
HDTV SIGNAL
HDTV (SDTV)

FIG. 84

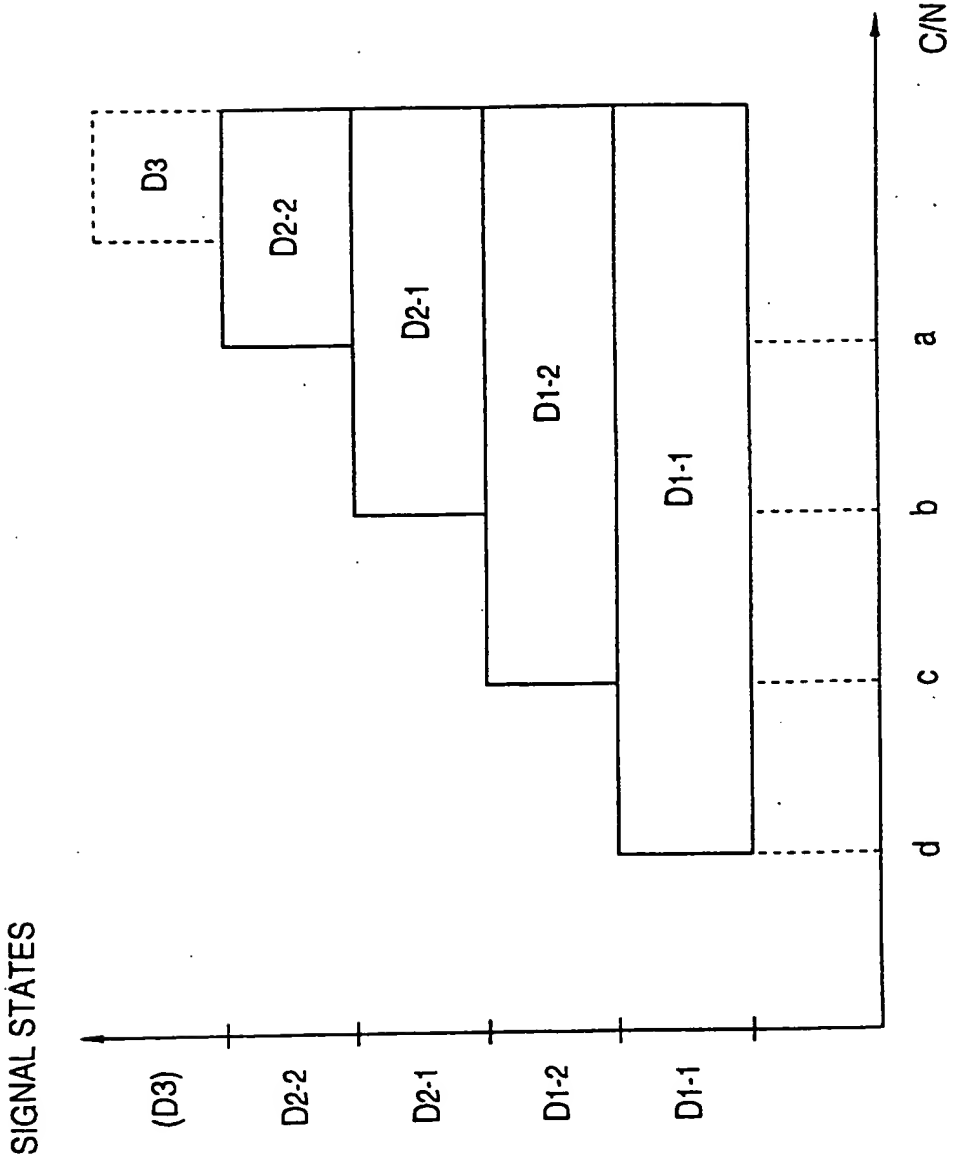
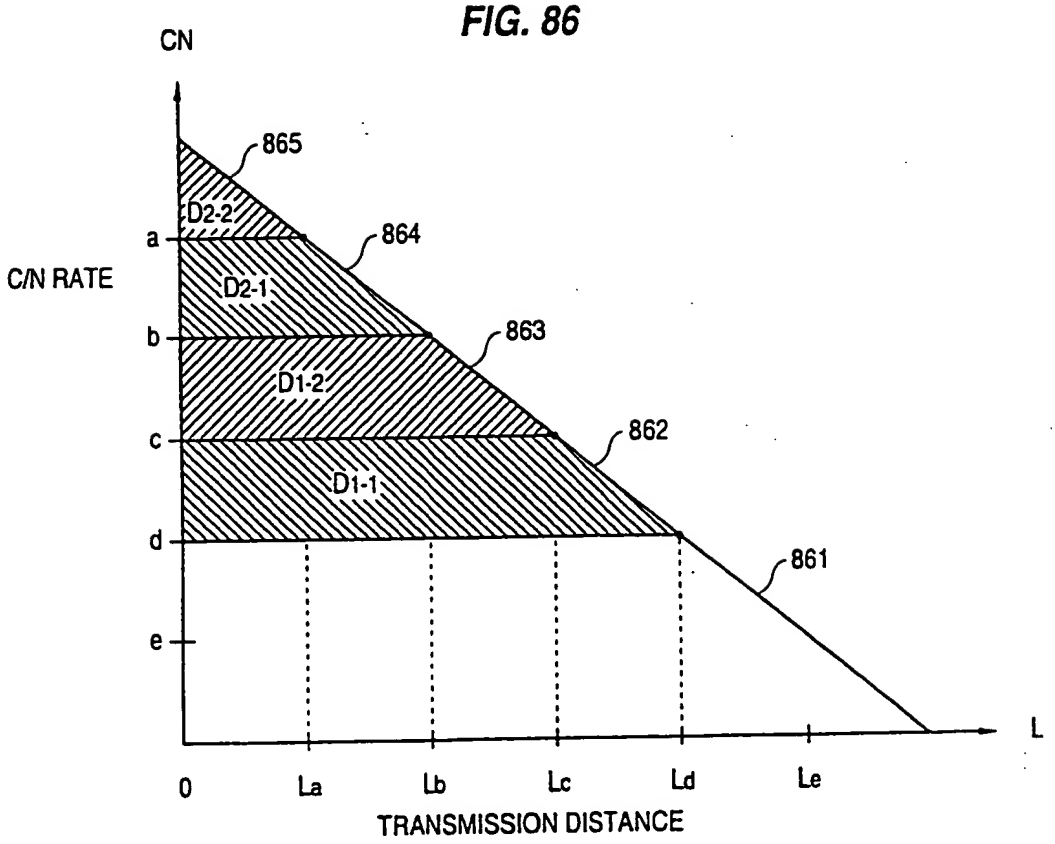


FIG. 85

FIG. 86


CN
C/N RATE
a
b
c
d
e
865
864
863
862
861
D2-2
D2-1
D1-2
D1-1
0
La
Lb
Lc
Ld
Le
L
TRANSMISSION DISTANCE

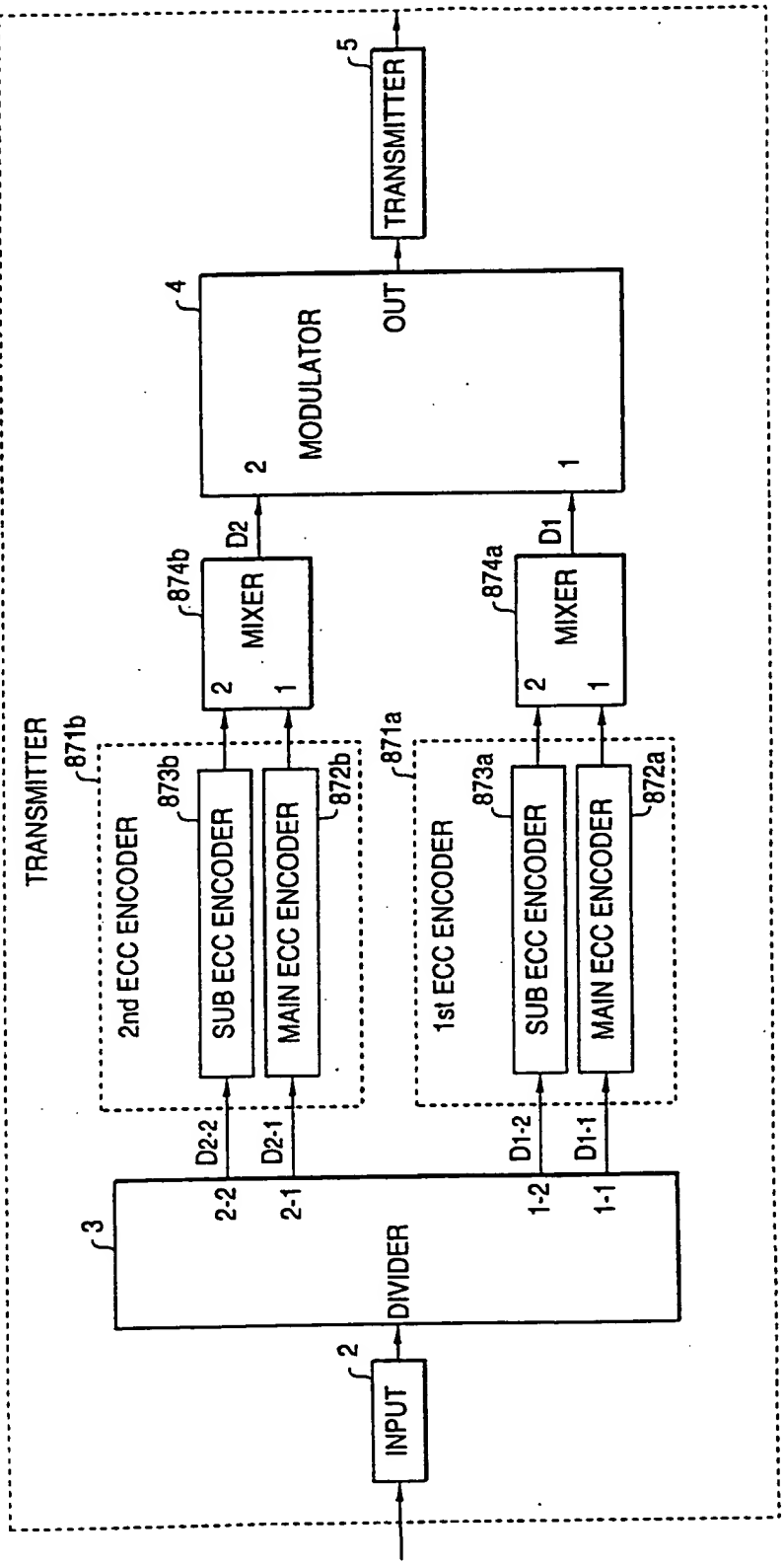

1
TRANSMITTER
5
TRANSMITTER
4
MODULATOR
OUT
2
1
874b
MIXER
874a
MIXER
D2
D1
871b
2nd ECC ENCODER
873b
SUB ECC ENCODER
872b
MAIN ECC ENCODER
871a
1st ECC ENCODER
873a
SUB ECC ENCODER
872a
MAIN ECC ENCODER
D2-2
D2-1
D1-2
D1-1
2-2
2-1
1-2
1-1
3
DIVIDER
2
INPUT

FIG. 87

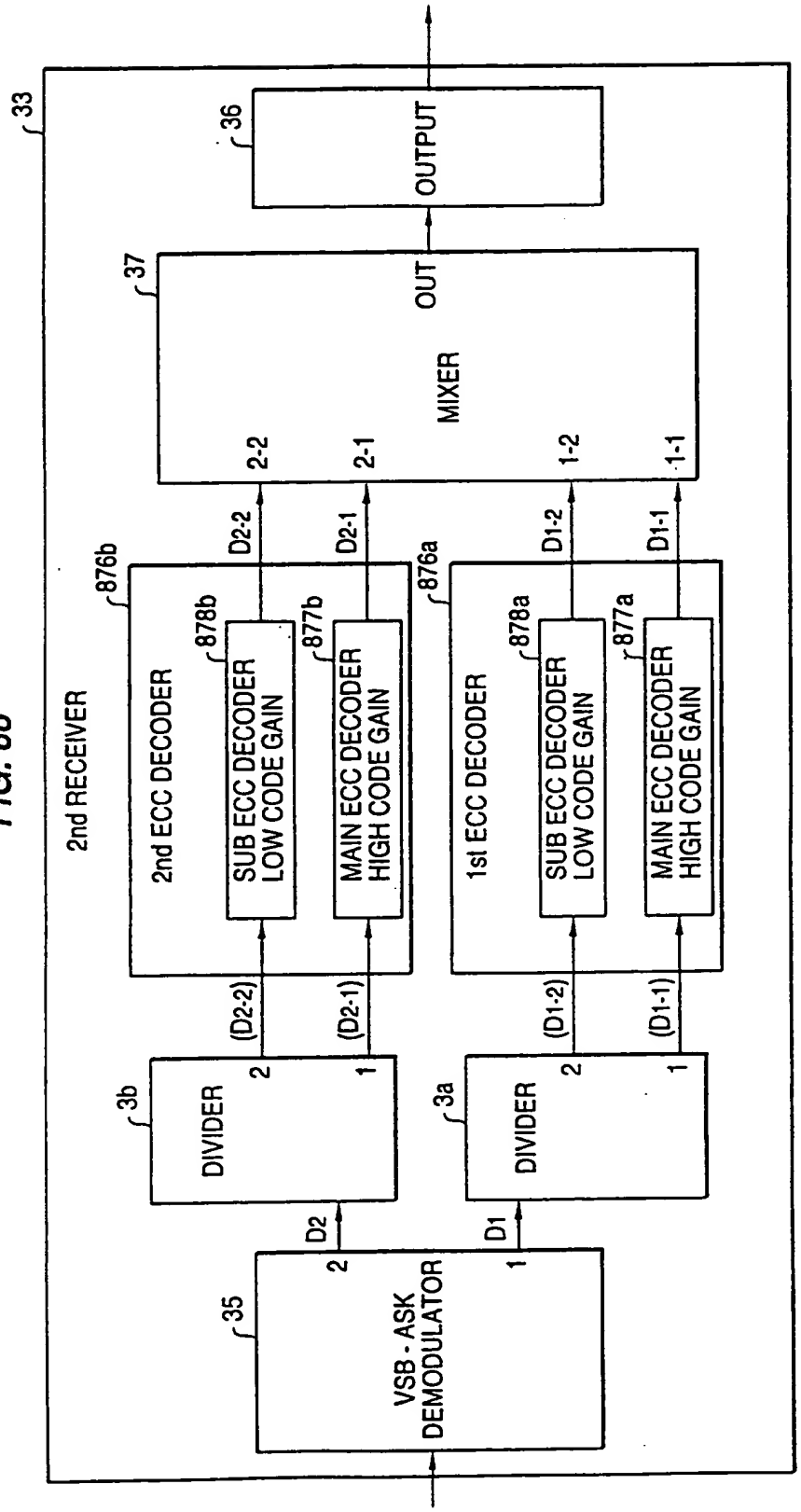
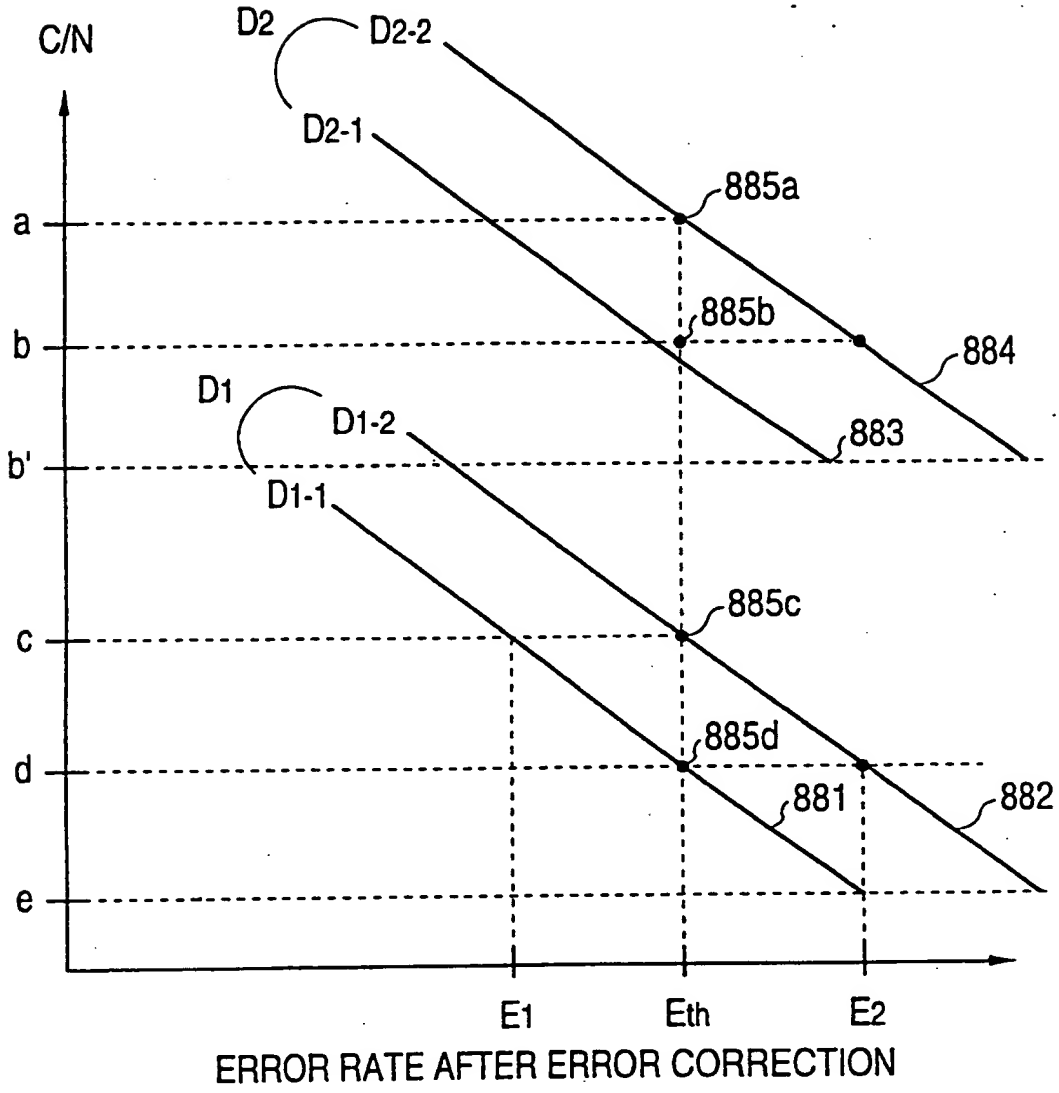

33
36
OUTPUT
37
OUT
MIXER
2-2
2-1
1-2
1-1
D2-2
D2-1
D1-2
D1-1
876b
876a
2nd RECEIVER
2nd ECC DECODER
1st ECC DECODER
878b
877b
878a
877a
SUB ECC DECODER LOW CODE GAIN
MAIN ECC DECODER HIGH CODE GAIN
(D2-2)
(D2-1)
(D1-2)
(D1-1)
2
1
3b
3a
DIVIDER
D2
D1
35
VSB - ASK DEMODULATOR

FIG. 88

FIG. 89


C/N
D2
D2-2
D2-1
885a
a
885b
b
884
D1
D1-2
883
b'
D1-1
885c
c
885d
d
881
882
e
E1
Eth
E2
ERROR RATE AFTER ERROR CORRECTION

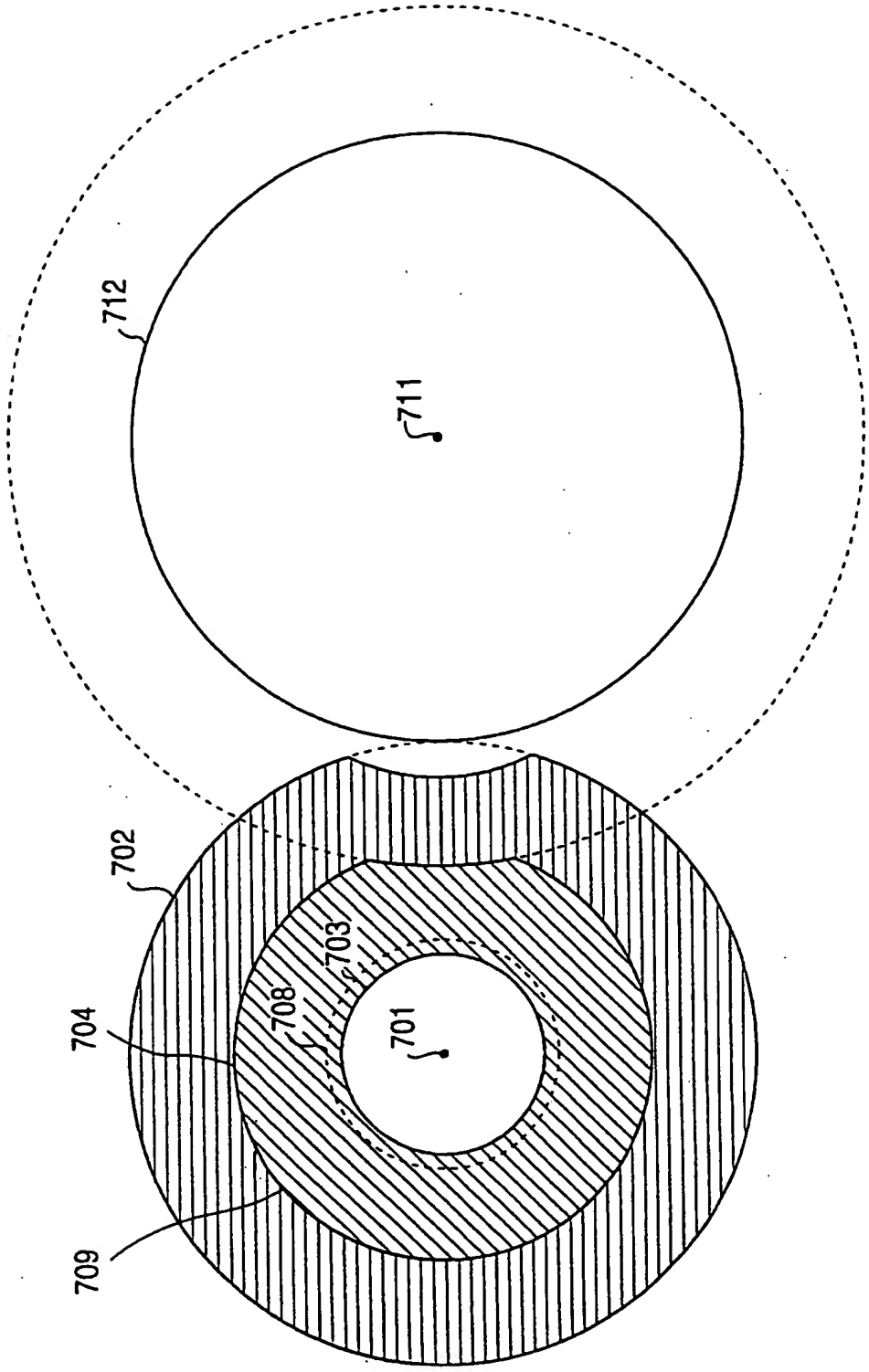


FIG. 90

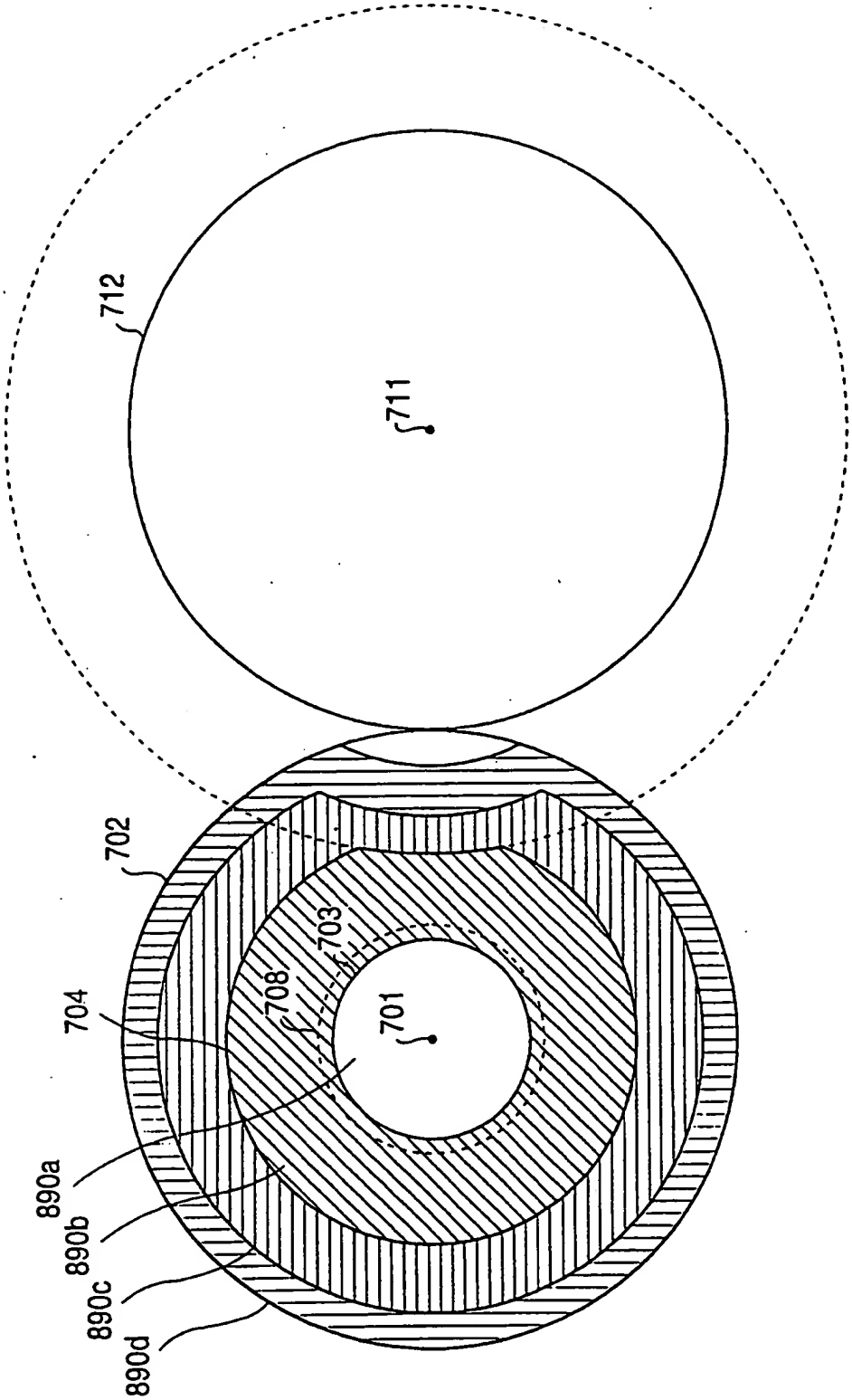
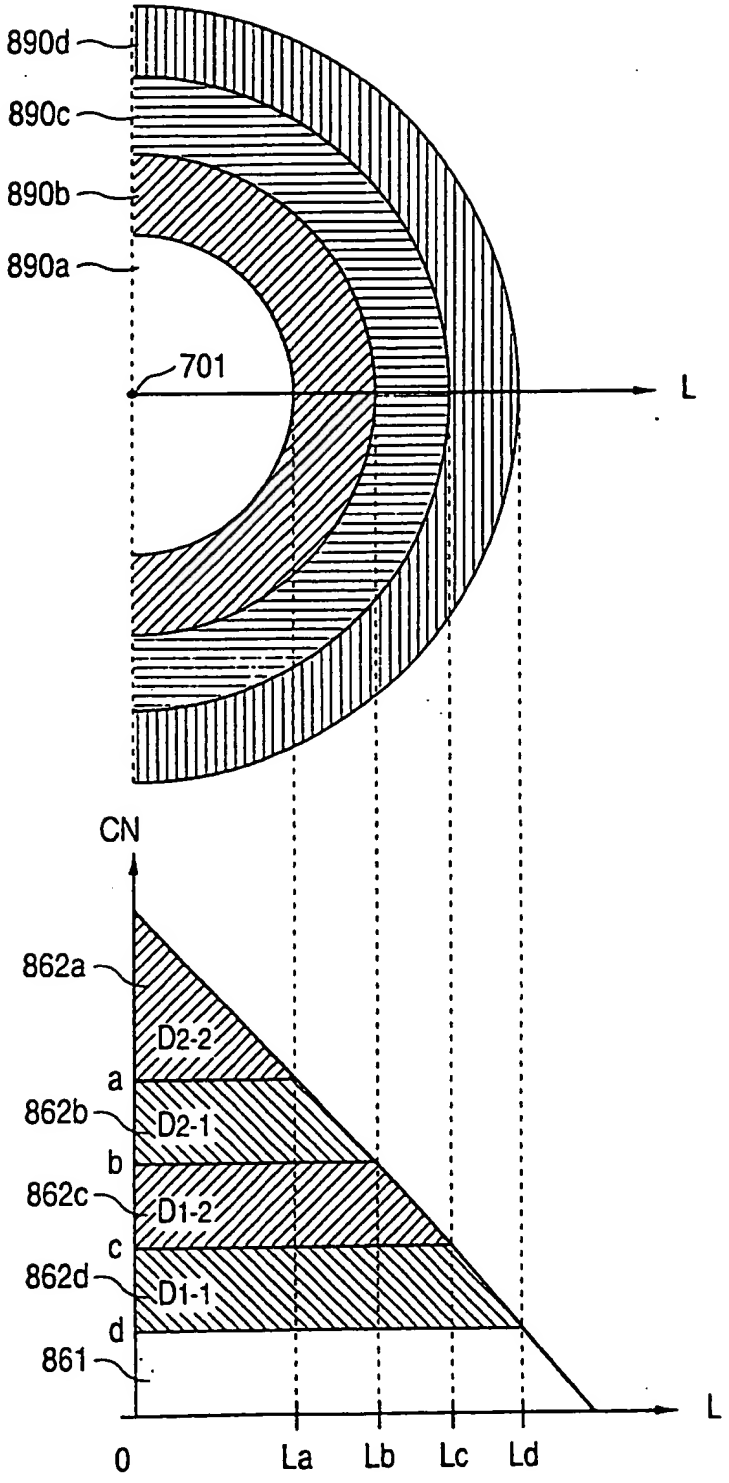


FIG. 91

FIG. 92


890d
890c
890b
890a
701
L
CN
862a
D2-2
a
862b
D2-1
b
862c
D1-2
c
862d
D1-1
d
861
L
0
La
Lb
Lc
Ld

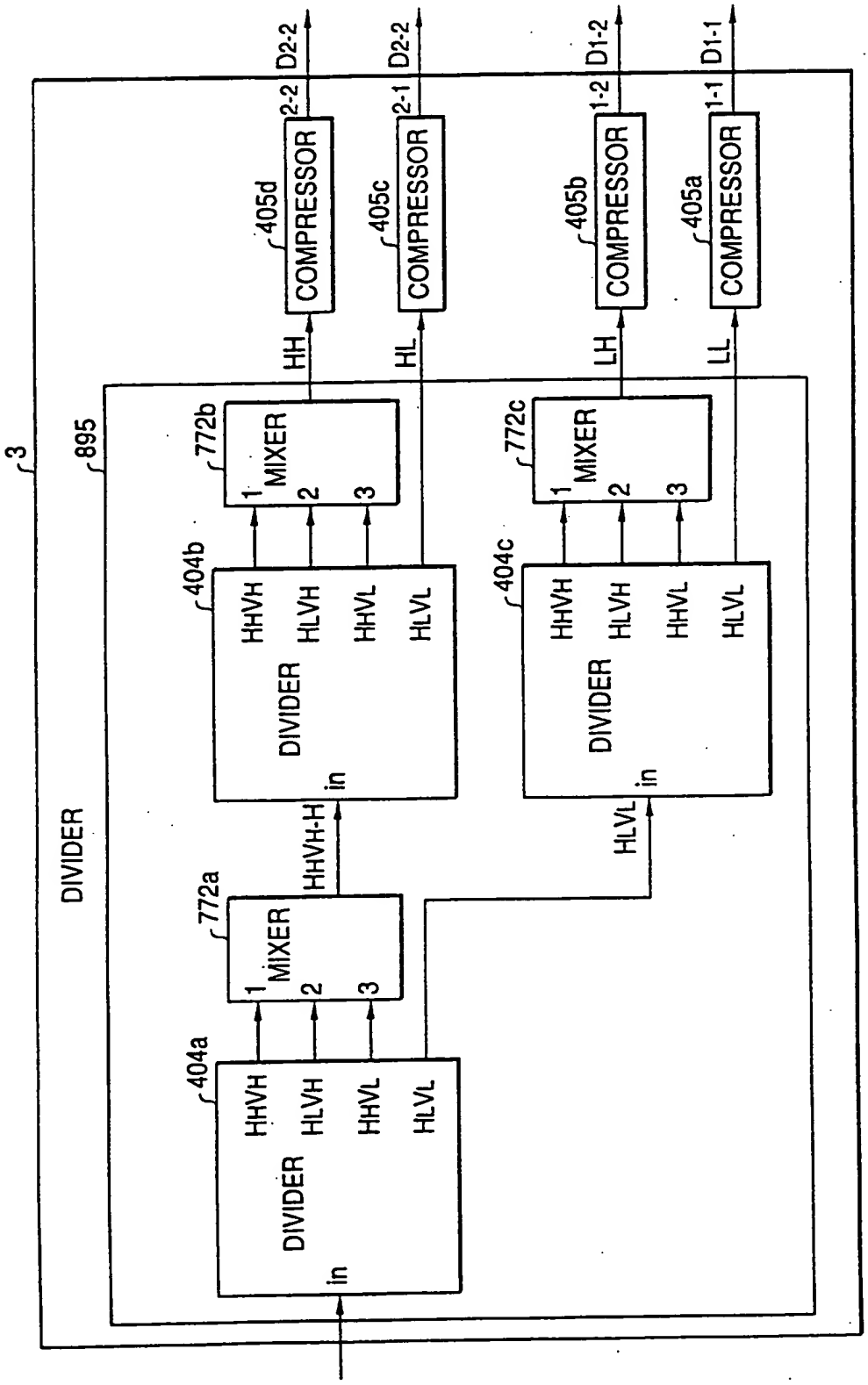

3
DIVIDER
895
404a
DIVIDER
HHVH
HLVH
HHVL
HLVL
in
772a
MIXER
1
2
3
HHVH-H
404b
DIVIDER
HHVH
HLVH
HHVL
HLVL
in
772b
MIXER
1
2
3
HH
HL
405d
COMPRESSOR
2-2
D2-2
405c
COMPRESSOR
2-1
D2-2
HLVL
404c
DIVIDER
HHVH
HLVH
HHVL
HLVL
in
772c
MIXER
1
2
3
LH
LL
405b
COMPRESSOR
1-2
D1-2
405a
COMPRESSOR
1-1
D1-1

FIG. 93

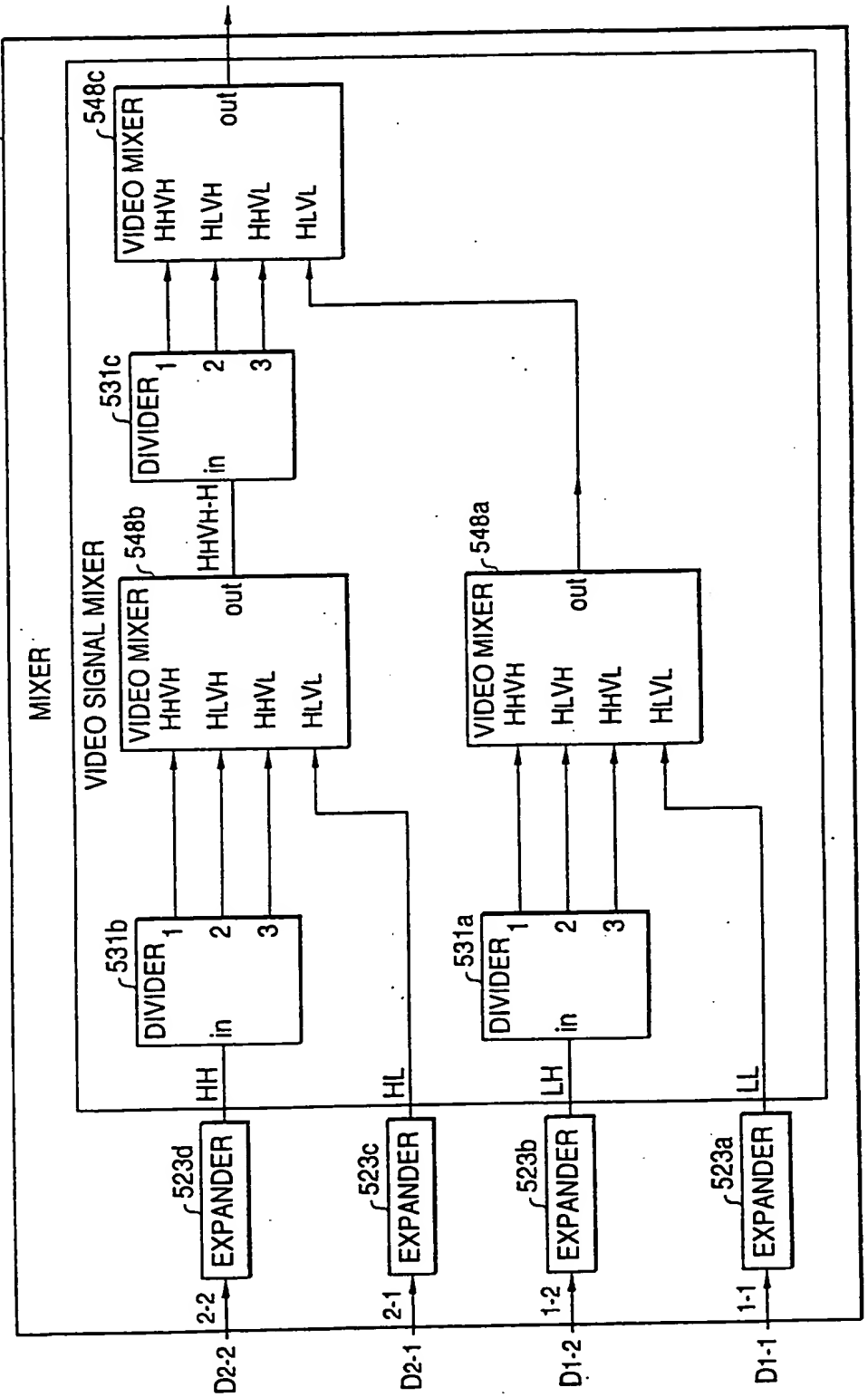
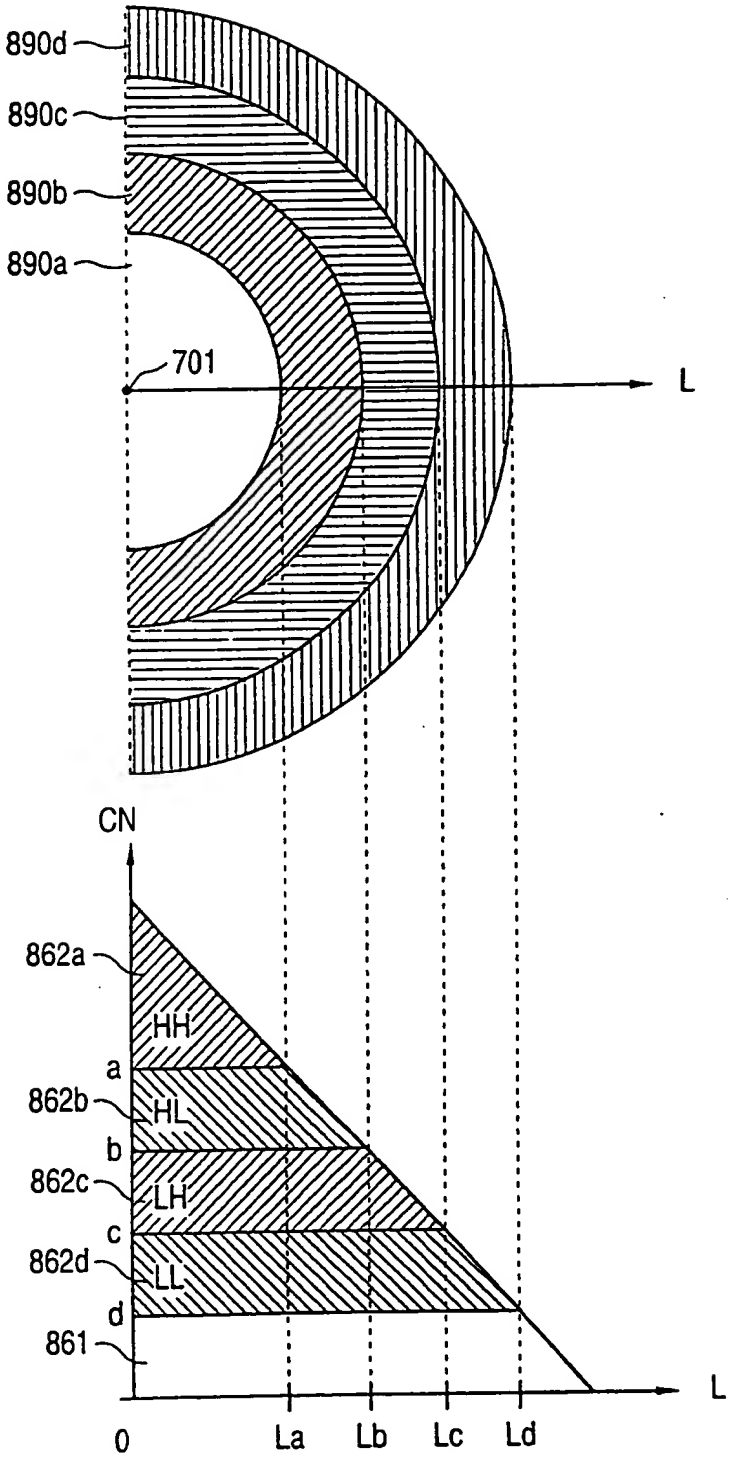

33
MIXER
VIDEO SIGNAL MIXER
548c
VIDEO MIXER
HHVH
HLVH
HHVL
HLVL
out
531c
DIVIDER
1
2
3
in
HHVH-H
548b
548a
531b
531a
HH
HL
LH
LL
523d
523c
523b
523a
EXPANDER
2-2
2-1
1-2
1-1
D2-2
D2-1
D1-2
D1-1

FIG. 94

FIG. 95


890d
890c
890b
890a
701
L
CN
862a
HH
a
862b
HL
b
862c
LH
c
862d
LL
d
861
L
0
La
Lb
Lc
Ld

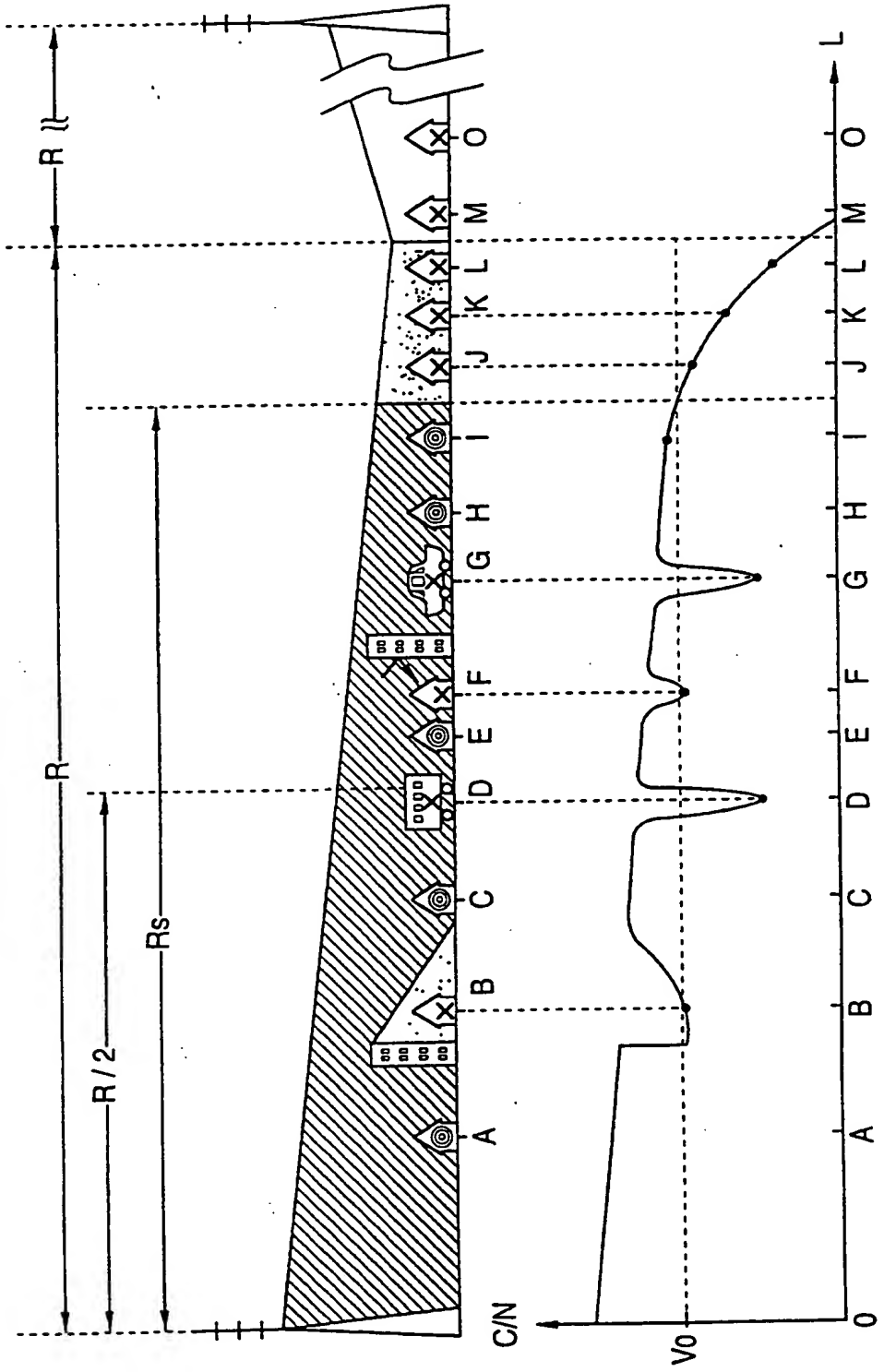


FIG. 96

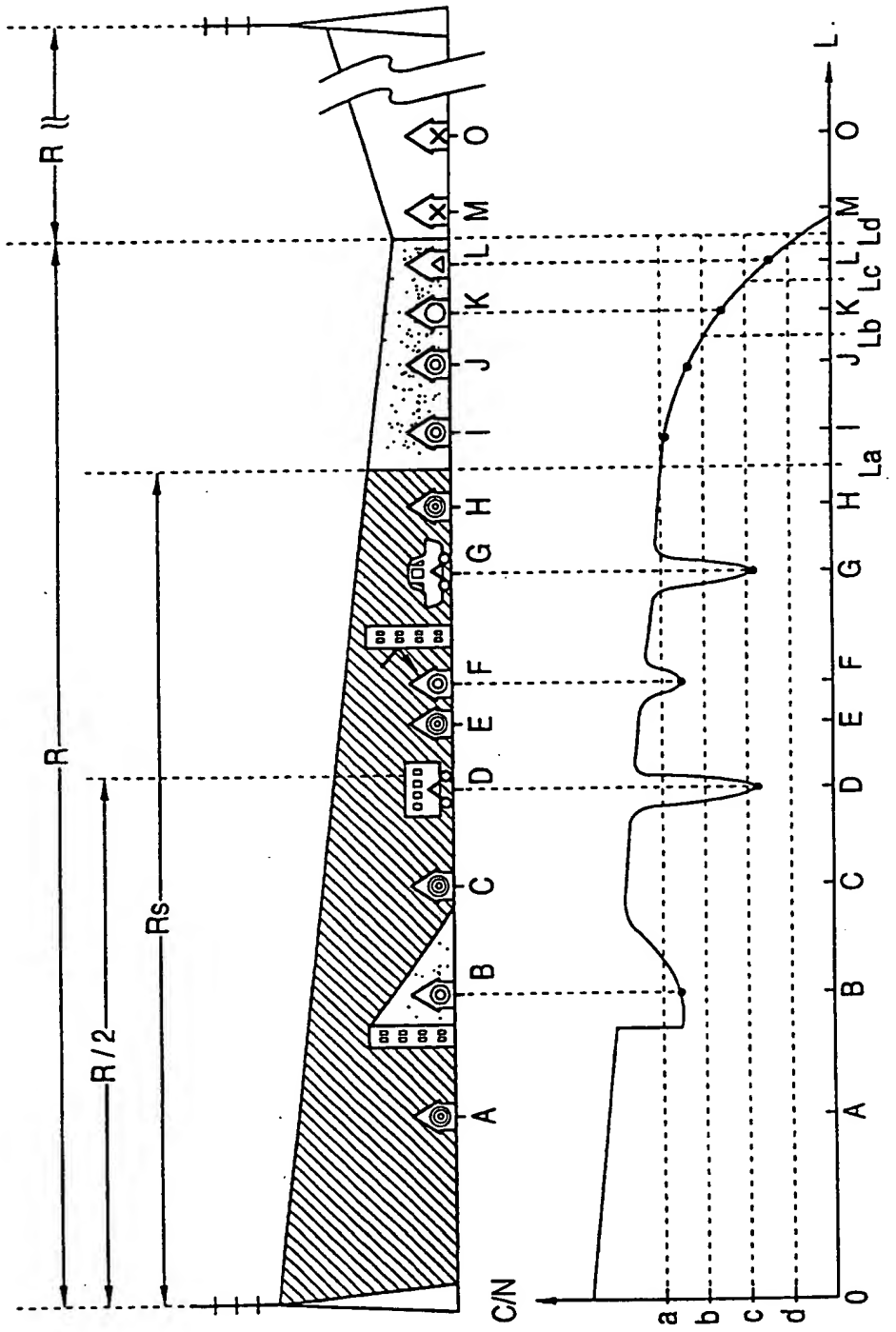


FIG. 97

FIG. 98

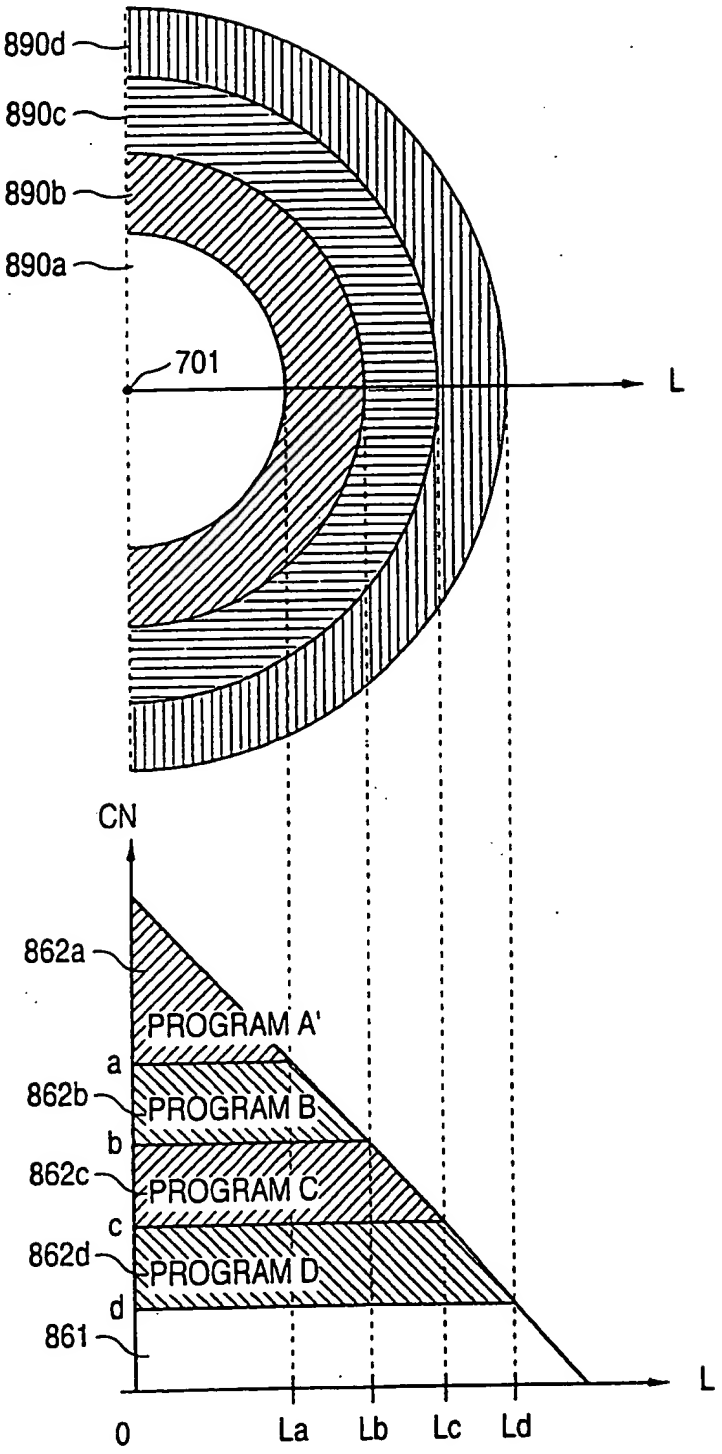

890d
890c
890b
890a
701
L
CN
862a
PROGRAM A'
a
862b
PROGRAM B
b
862c
PROGRAM C
c
862d
PROGRAM D
d
861
L
0
La
Lb
Lc
Ld

FIG. 99

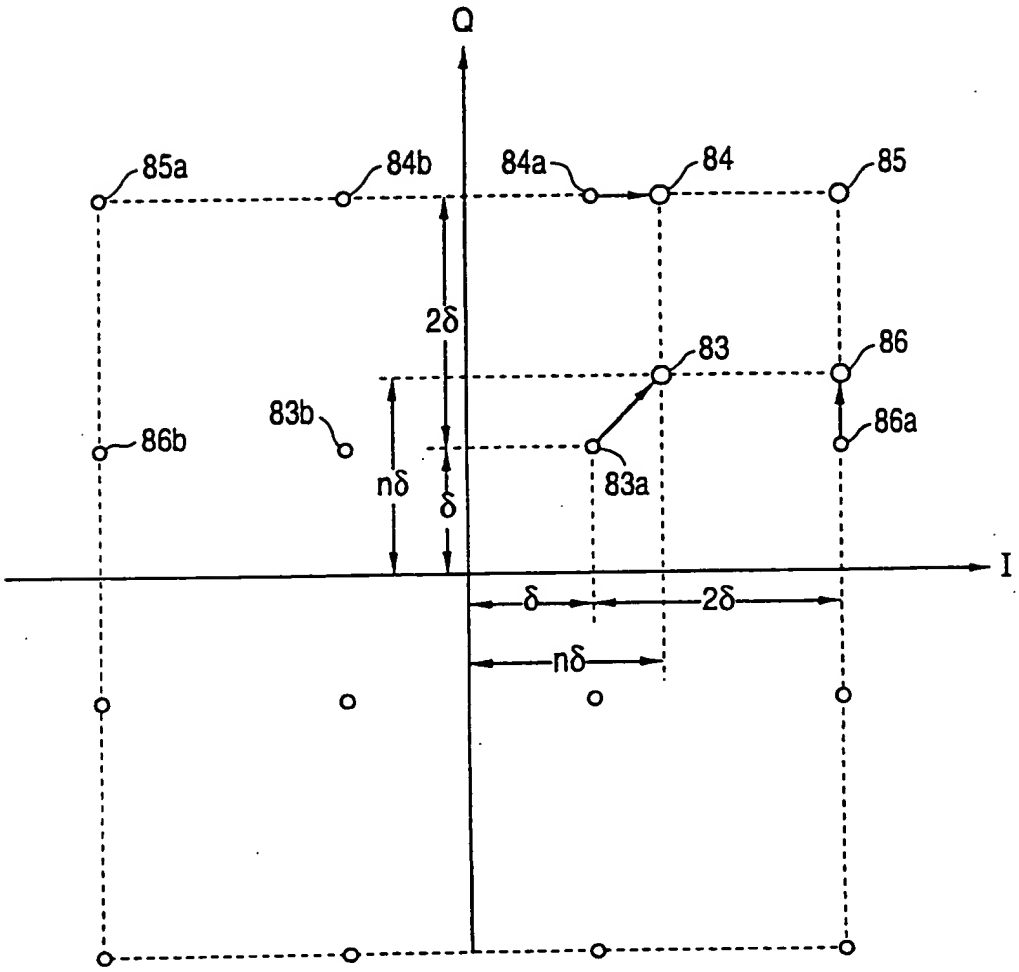


FIG. 100

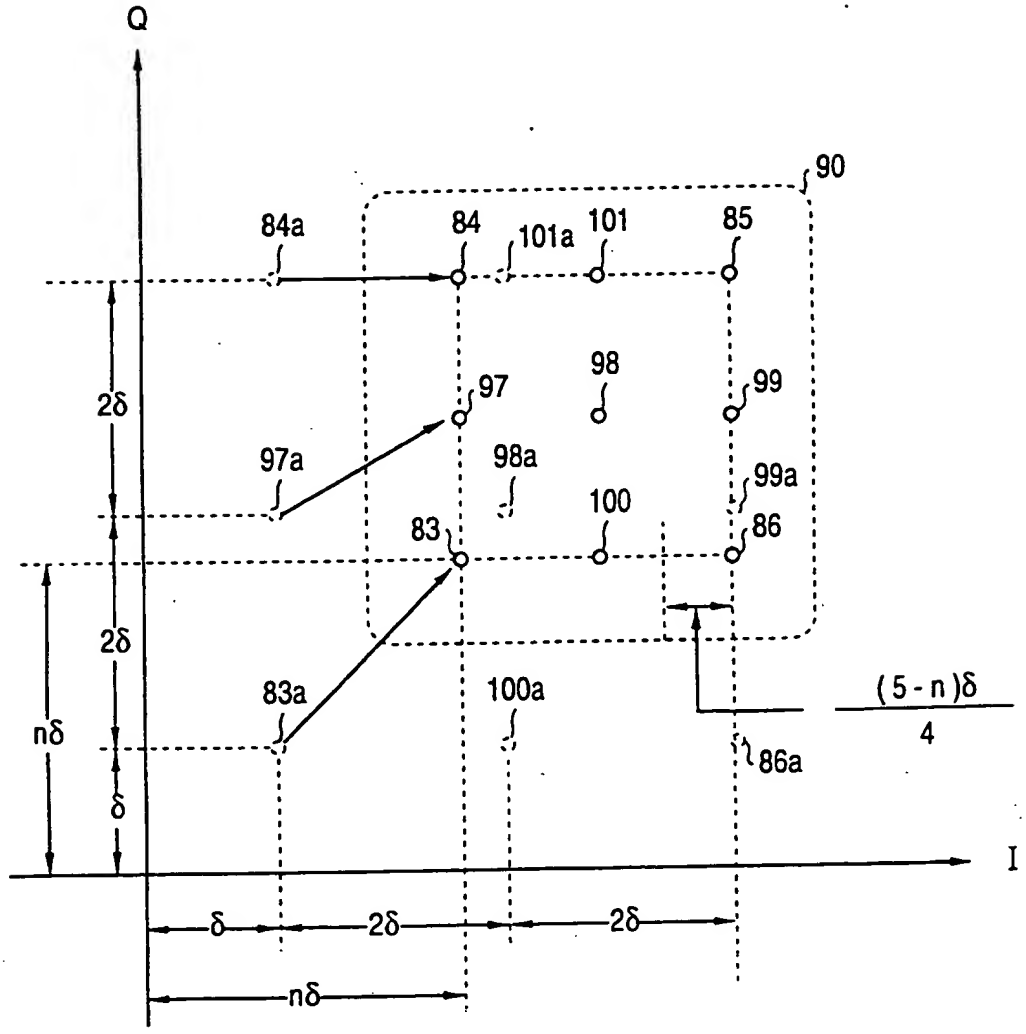

Q
I
90
84a
84
101a
101
85
97
98
99
97a
98a
99a
100
83
86
83a
100a
86a
2δ
2δ
nδ
δ
δ
2δ
2δ
nδ
(5 - n)δ
4

FIG. 101

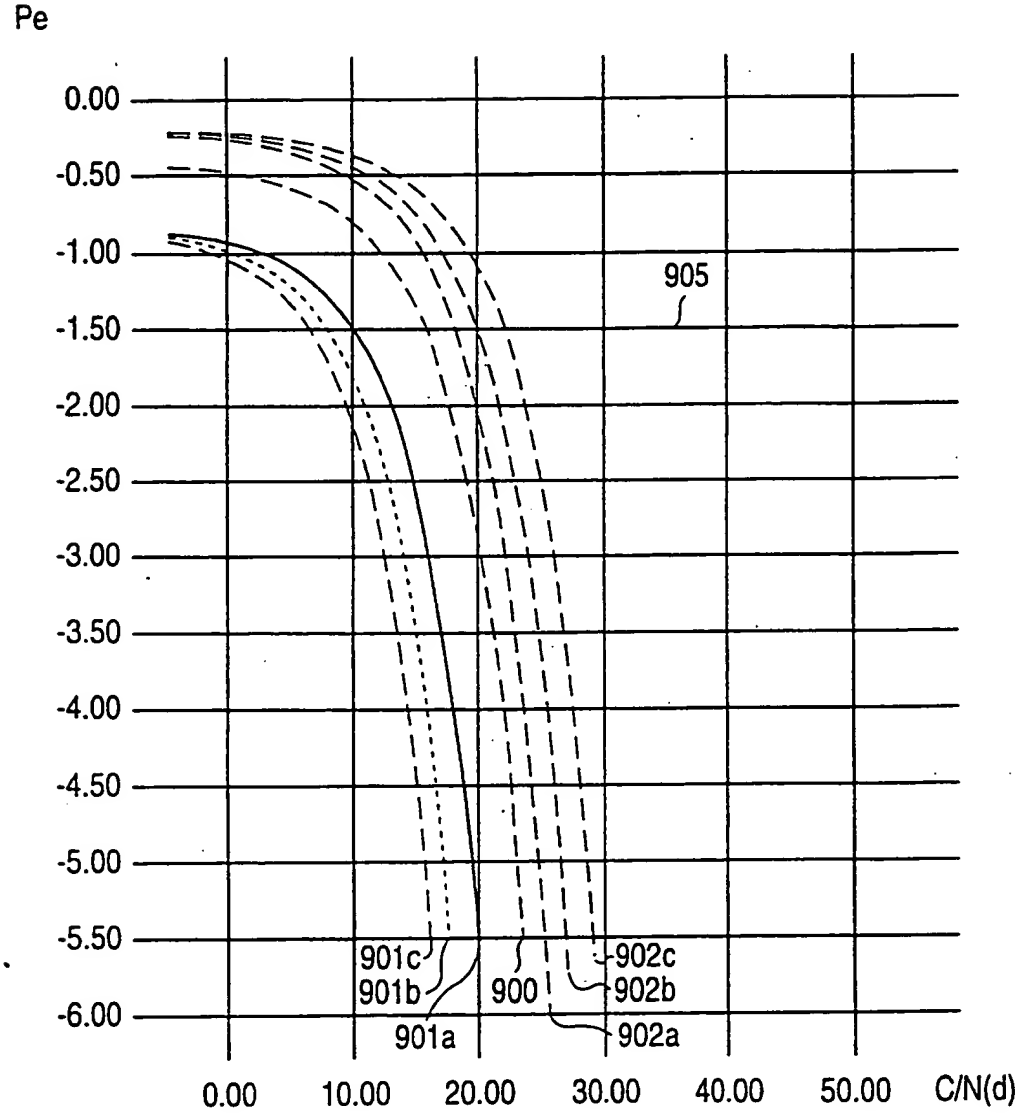

Pe
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
-5.00
-5.50
-6.00
905
901c
901b
901a
900
902c
902b
902a
0.00
10.00
20.00
30.00
40.00
50.00
C/N(d)

FIG. 102

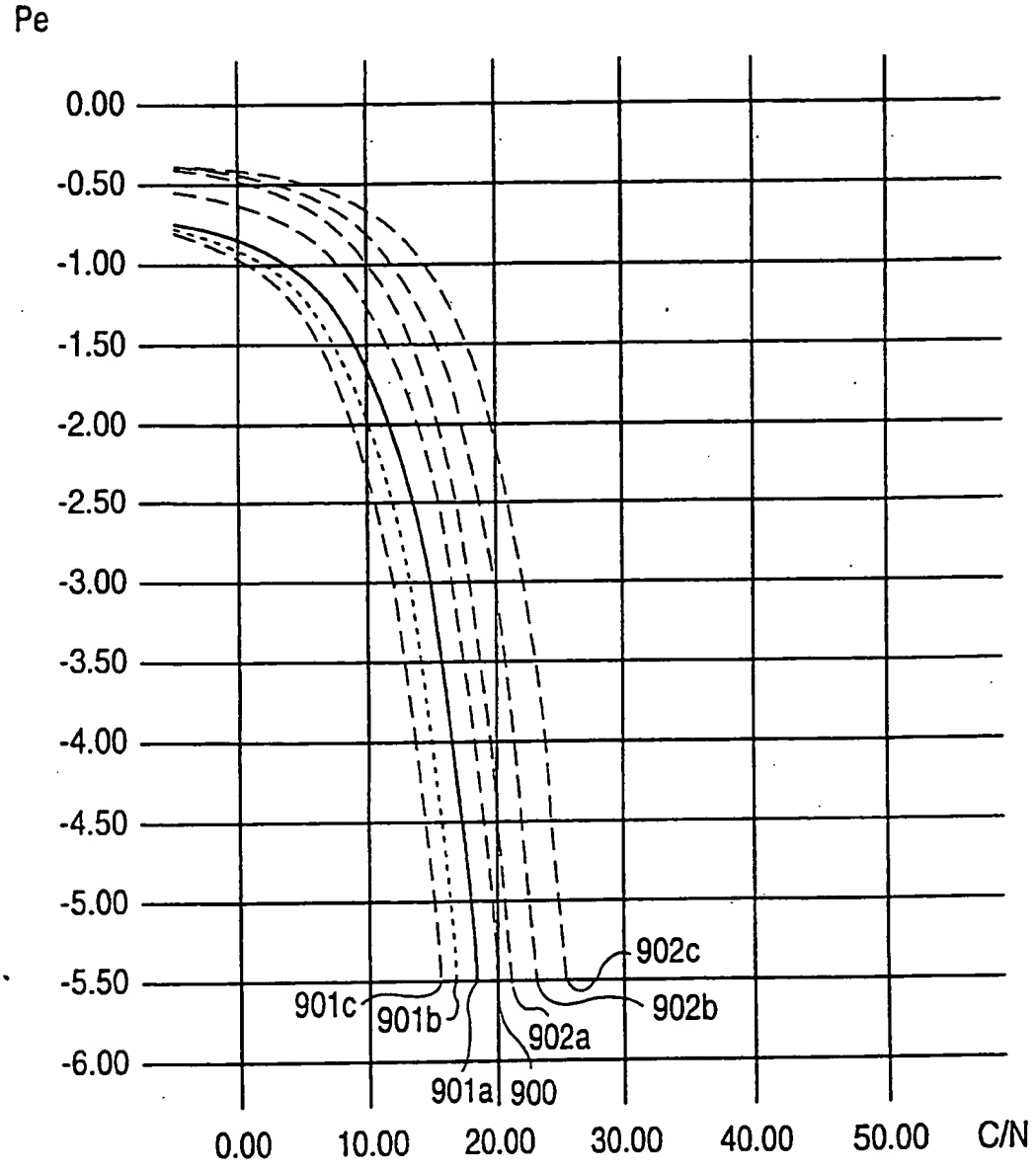

Pe
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
-3.50
-4.00
-4.50
-5.00
-5.50
-6.00
0.00
10.00
20.00
30.00
40.00
50.00
C/N
901c
901b
901a
900
902a
902b
902c

FIG. 103

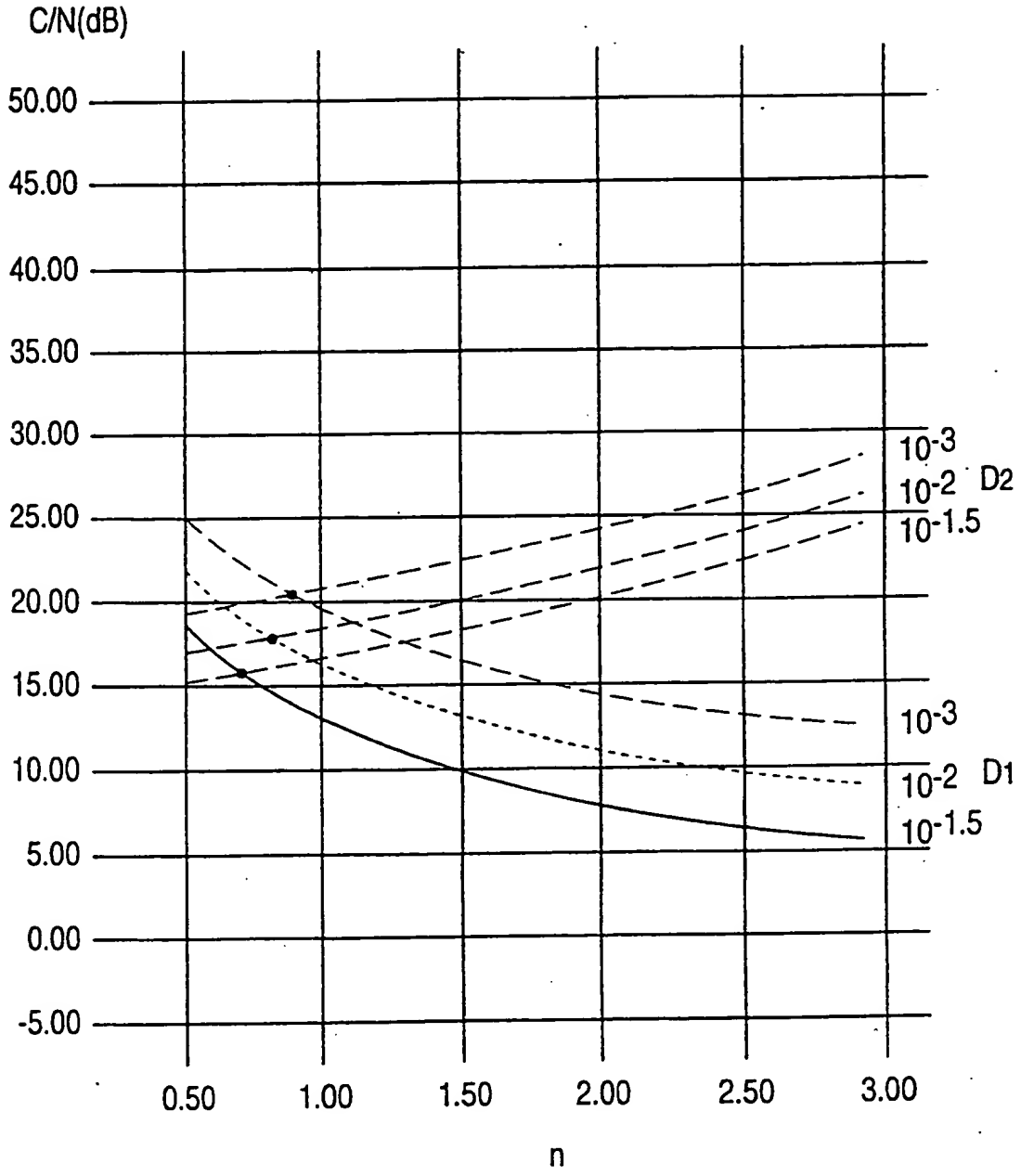
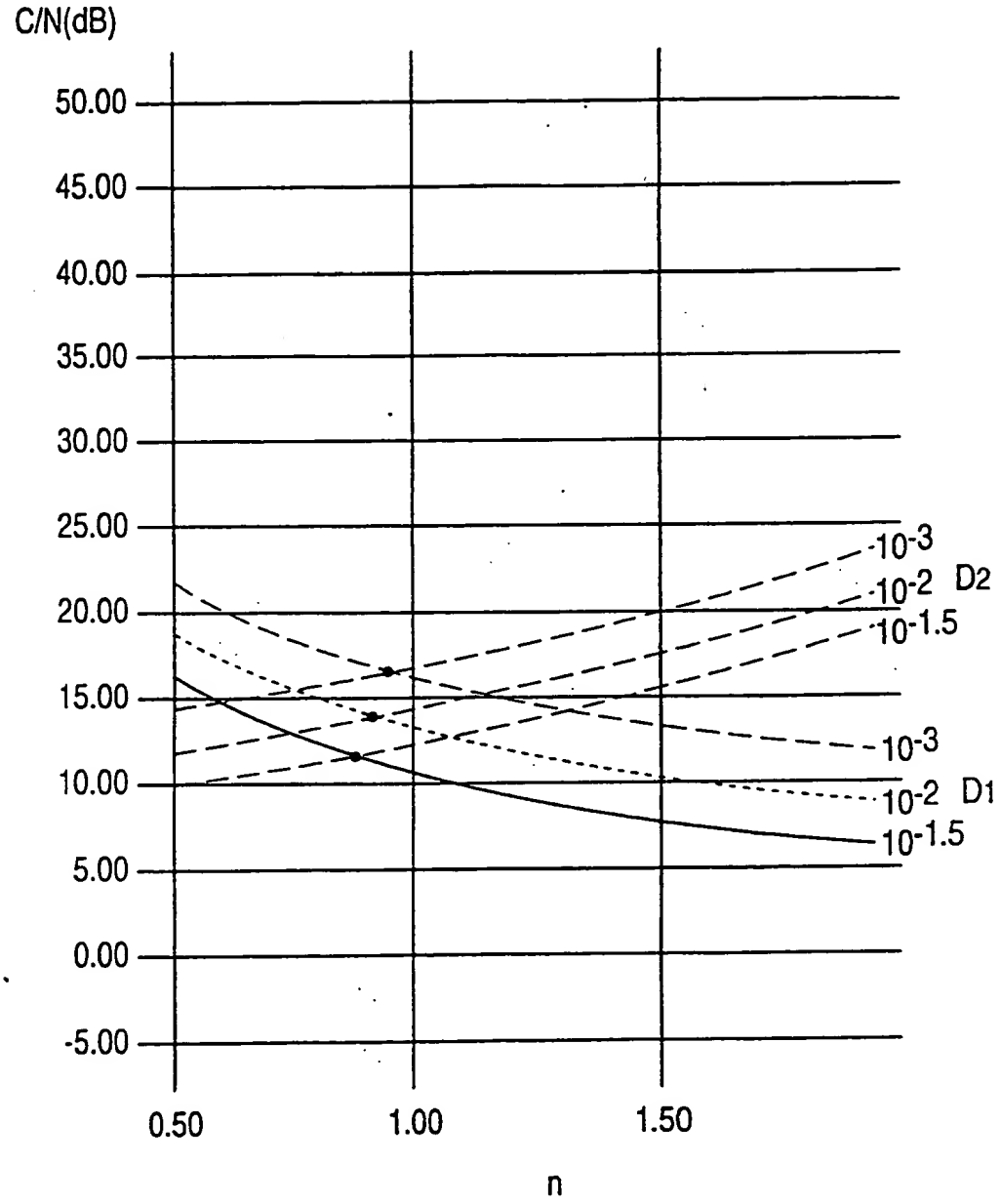

C/N(dB)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
0.50
1.00
1.50
2.00
2.50
3.00
n
10-3
10-2 D2
10-1.5
10-3
10-2 D1
10-1.5

FIG. 104


C/N(dB)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
-5.00
0.50
1.00
1.50
n
10-3
10-2 D2
10-1.5
10-3
10-2 D1
10-1.5

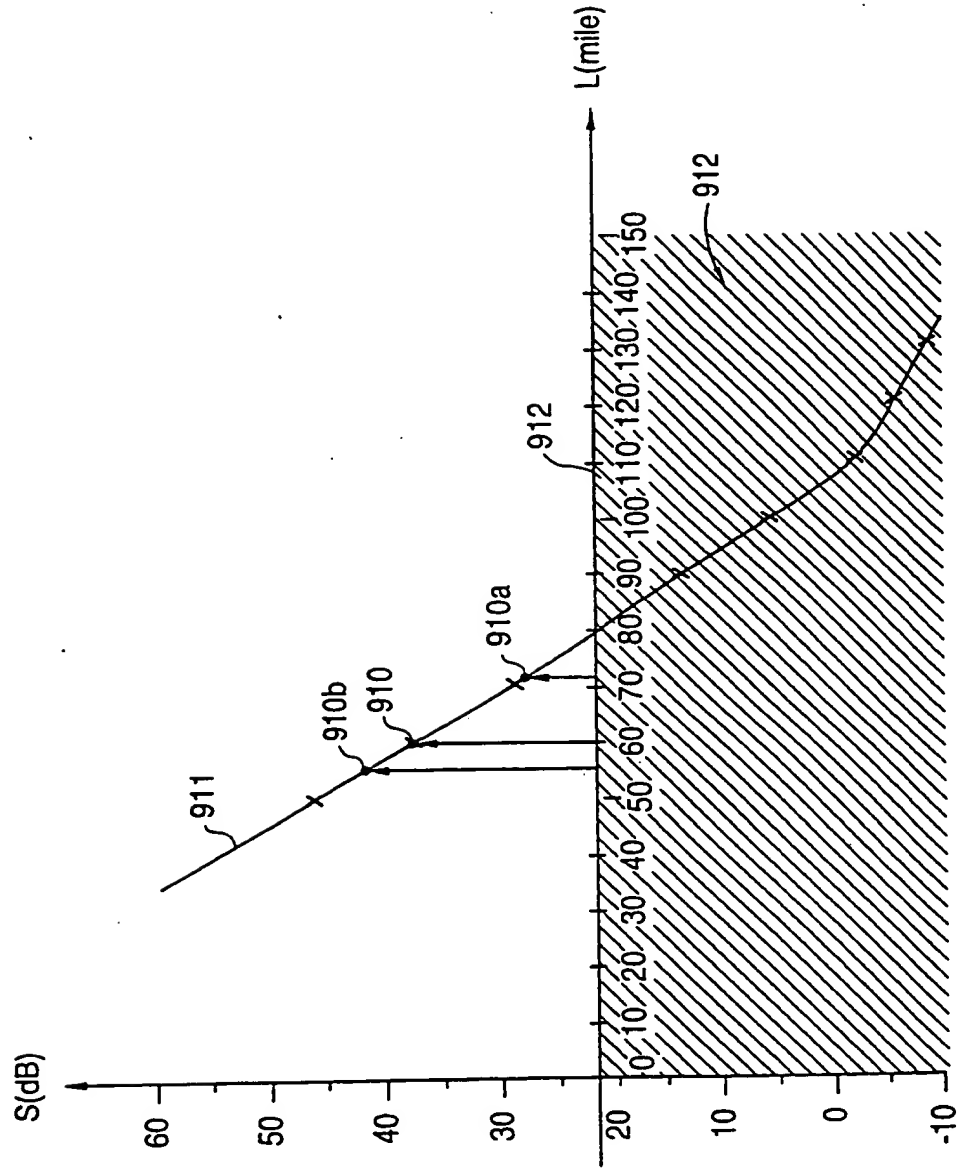
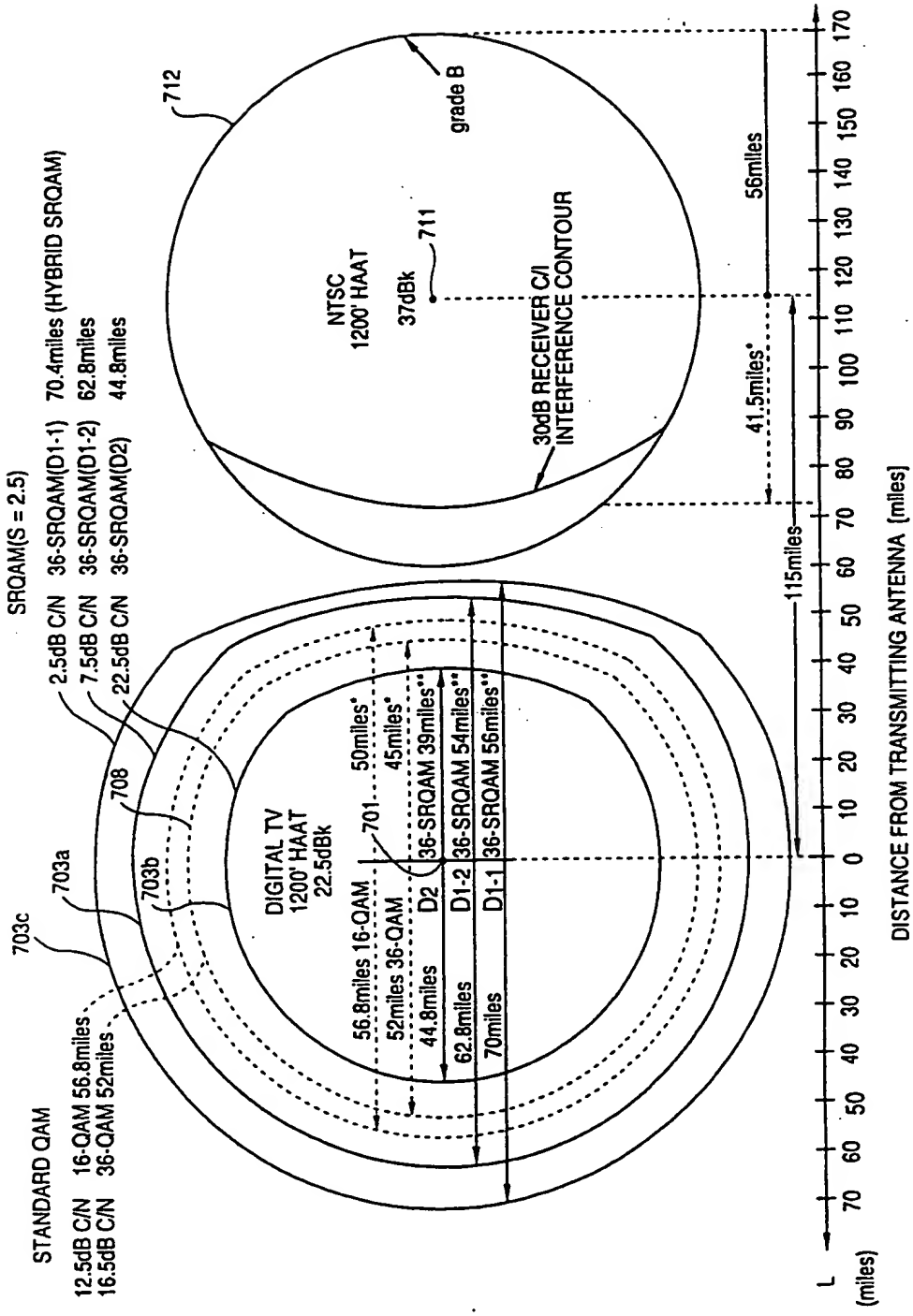

L(mile)
S(dB)
911
910b
910
910a
912
912
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
60
50
40
30
20
10
0
-10

FIG. 105

FIG. 106


SRQAM(S = 2.5)
2.5dB C/N 36-SRQAM(D1-1) 70.4miles (HYBRID SRQAM)
7.5dB C/N 36-SRQAM(D1-2) 62.8miles
22.5dB C/N 36-SRQAM(D2) 44.8miles
STANDARD QAM
12.5dB C/N 16-QAM 56.8miles
16.5dB C/N 36-QAM 52miles
703c
703a
703b
708
712
711
701
DIGITAL TV
1200' HAAT
22.5dBk
NTSC
1200' HAAT
37dBk
grade B
30dB RECEIVER C/I
INTERFERENCE CONTOUR
56.8miles 16-QAM
52miles 36-QAM
44.8miles
62.8miles
70miles
50miles'
45miles'
36-SRQAM 39miles''
36-SRQAM 54miles''
36-SRQAM 56miles''
D2
D1-2
D1-1
56miles
41.5miles'
115miles
L (miles)
DISTANCE FROM TRANSMITTING ANTENNA (miles)

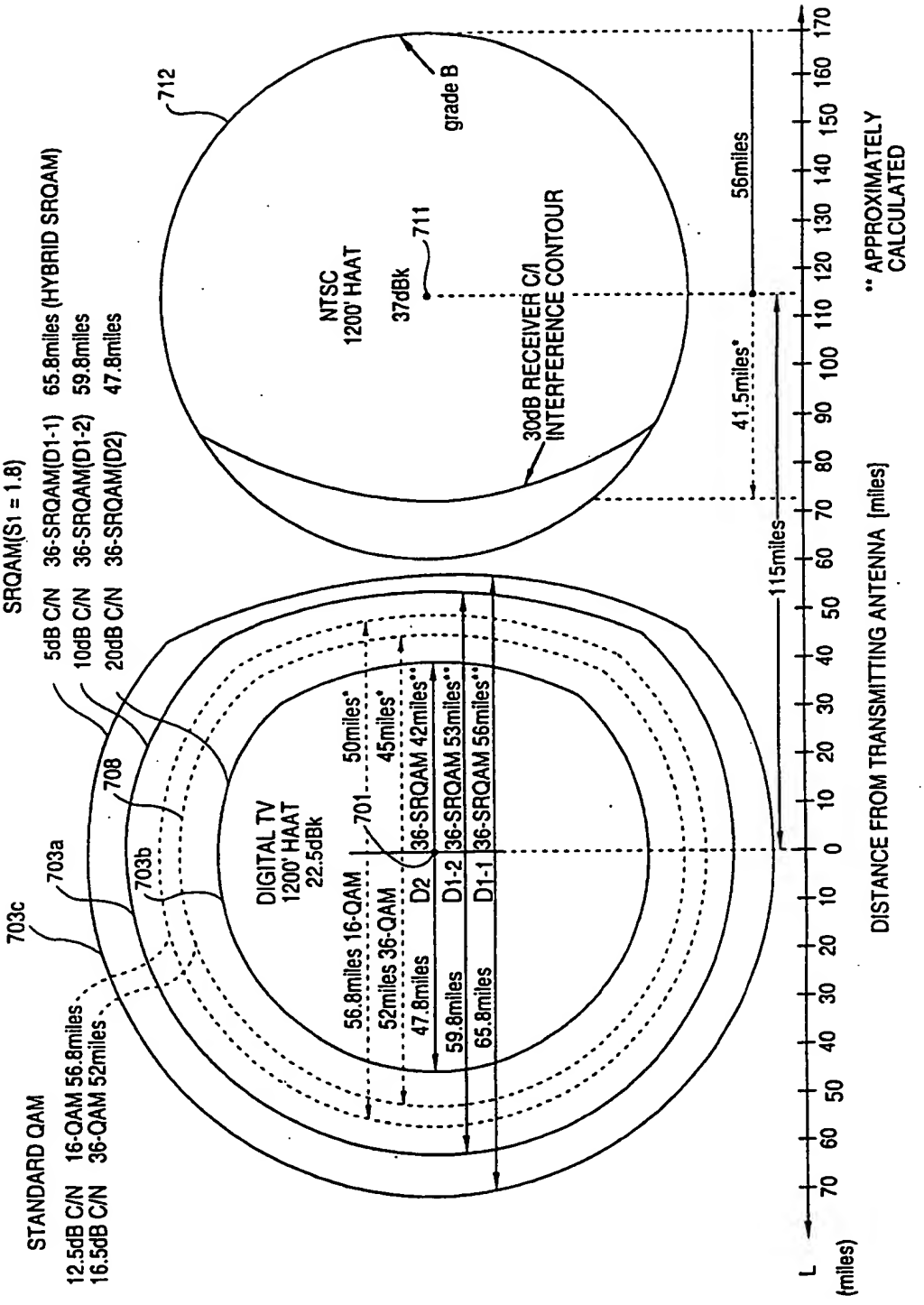

SRQAM(S1 = 1.8)
5dB C/N 36-SRQAM(D1-1) 65.8miles (HYBRID SRQAM)
10dB C/N 36-SRQAM(D1-2) 59.8miles
20dB C/N 36-SRQAM(D2) 47.8miles
STANDARD QAM
12.5dB C/N 16-QAM 56.8miles
16.5dB C/N 36-QAM 52miles
703c
703a
703b
708
712
grade B
NTSC
1200' HAAT
37dBk
711
30dB RECEIVER C/I
INTERFERENCE CONTOUR
DIGITAL TV
1200' HAAT
22.5dBk
701
56.8miles 16-QAM
52miles 36-QAM
47.8miles
59.8miles
65.8miles
50miles*
45miles*
36-SRQAM 42miles**
36-SRQAM 53miles**
36-SRQAM 56miles**
D2
D1-2
D1-1
115miles
56miles
41.5miles*
** APPROXIMATELY CALCULATED
DISTANCE FROM TRANSMITTING ANTENNA (miles)
L (miles)
70 60 50 40 30 20 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170

FIG. 107

FIG. 108(a)

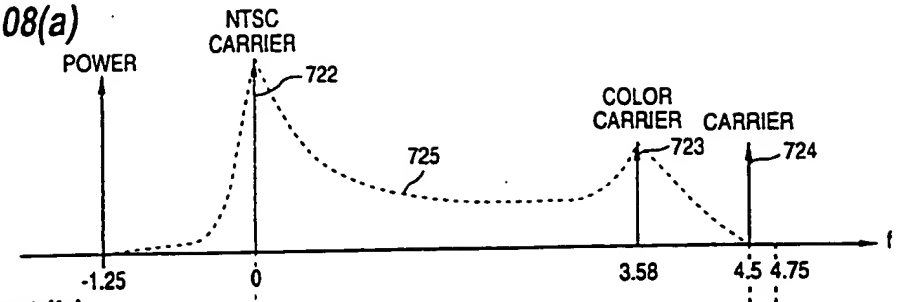


FIG. 108(b)

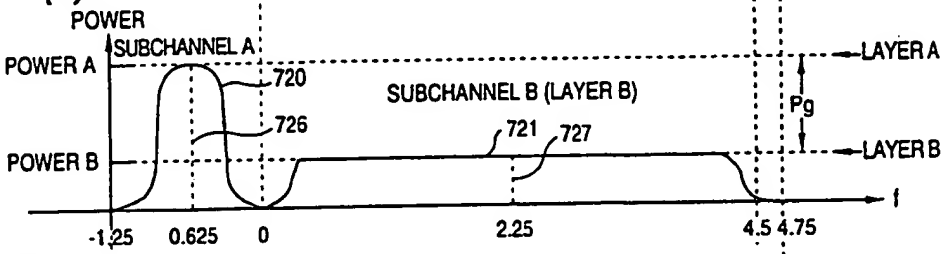


FIG. 108(c)

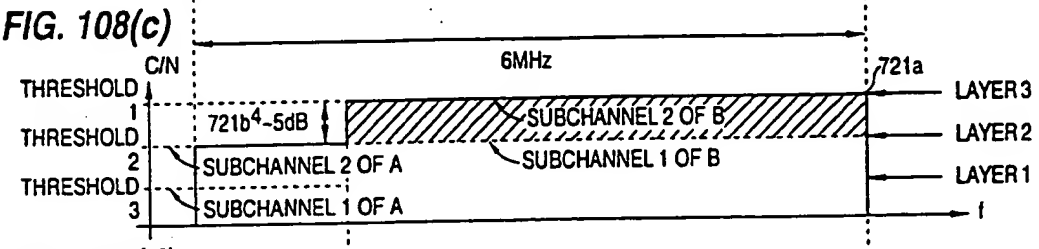


FIG. 108(d)

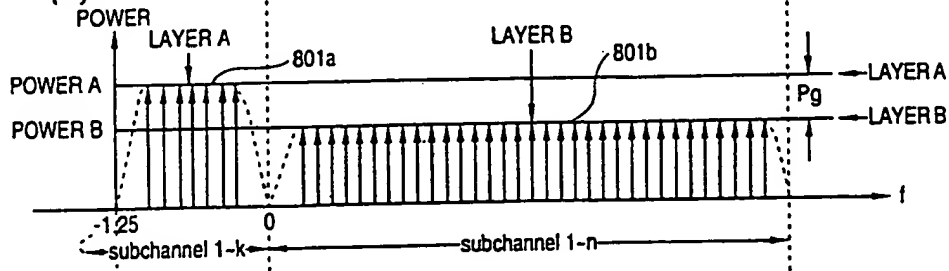


FIG. 108(e)

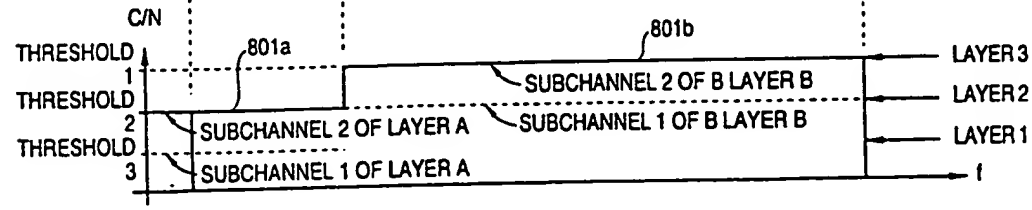
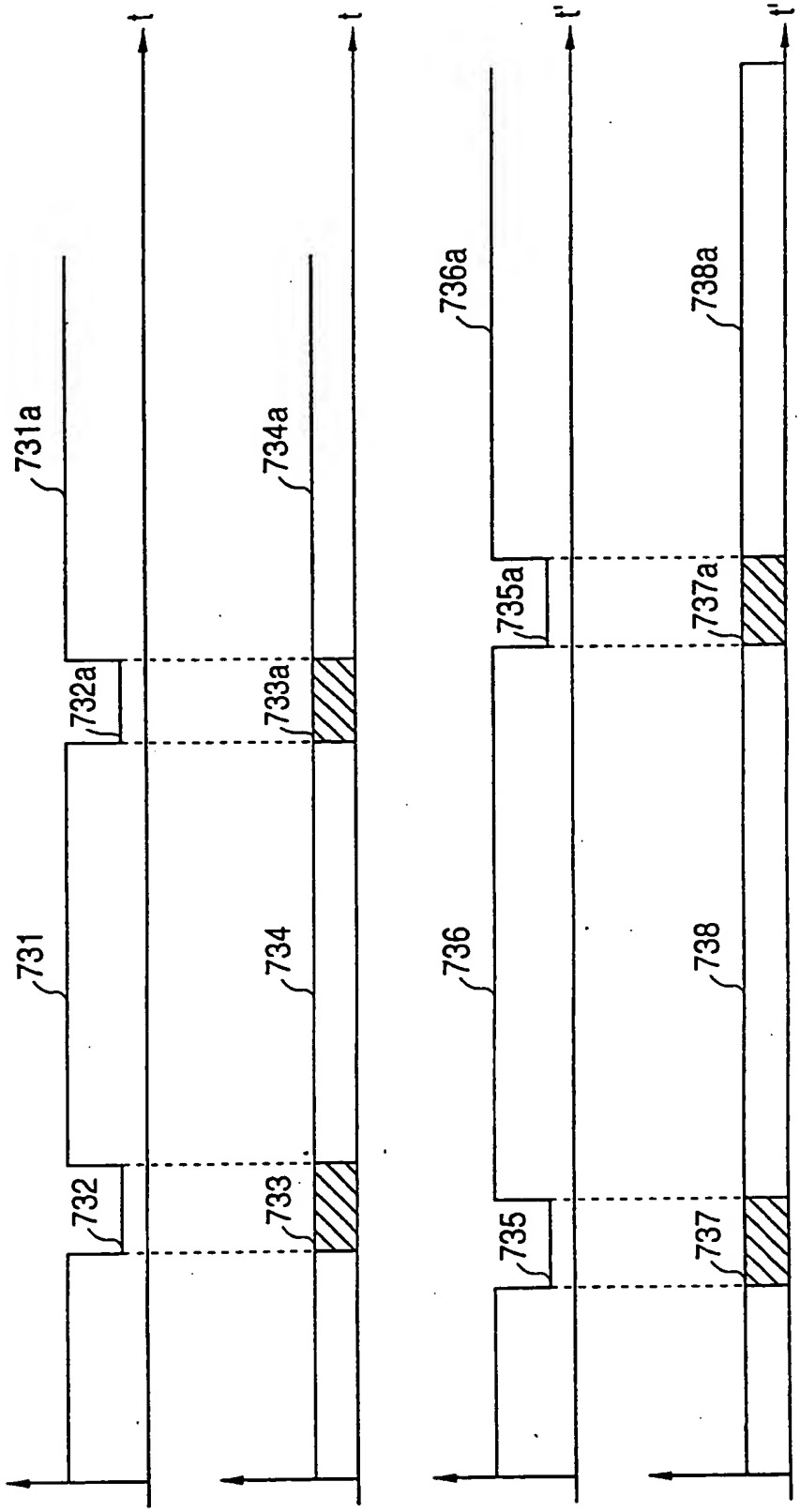


FIG. 109


t
t
t'
t''
731a
734a
736a
738a
732a
733a
735a
737a
731
734
736
738
732
733
735
737

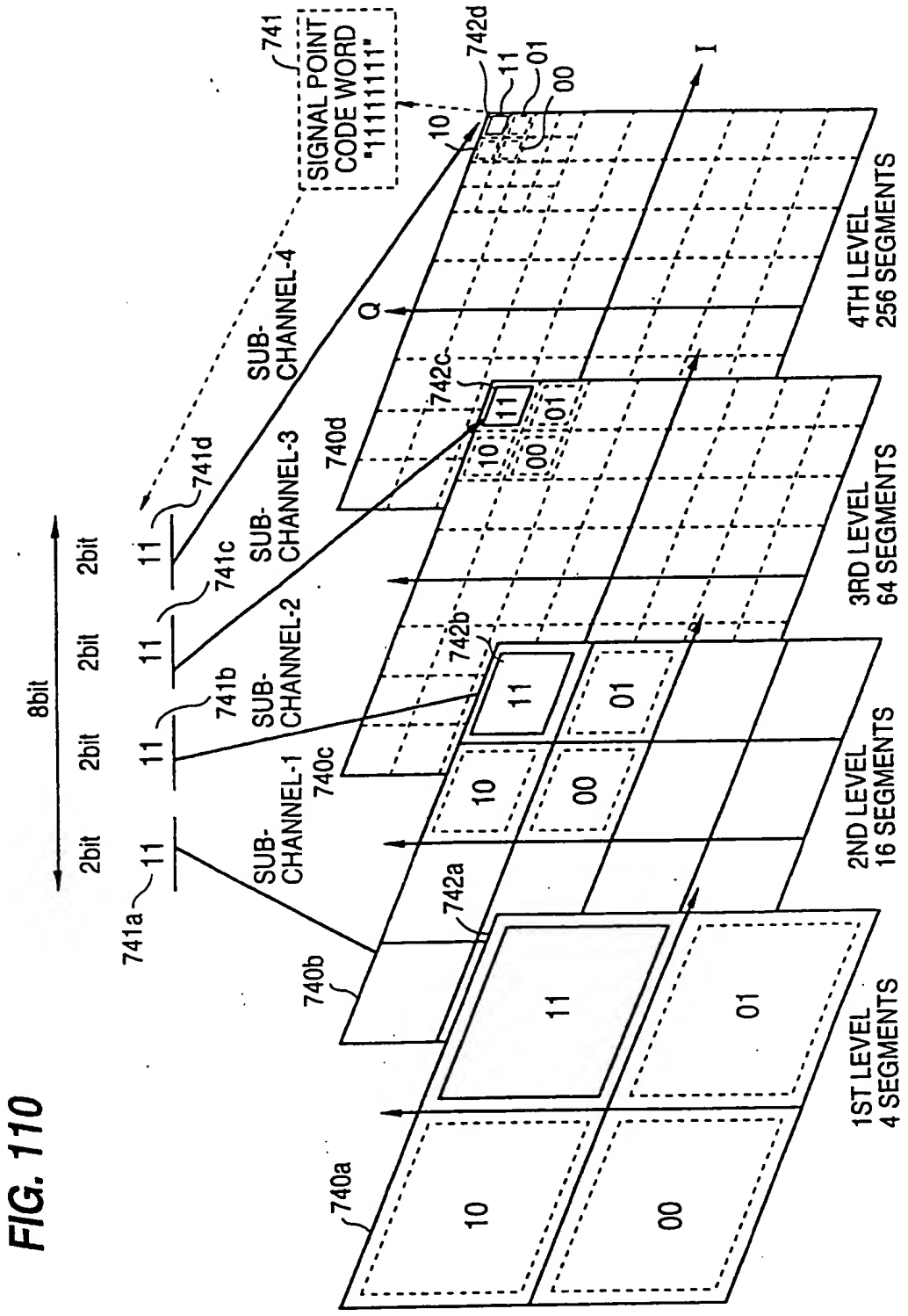

8bit
2bit 2bit 2bit 2bit
11 11 11 11
741a 741b 741c 741d
SUB-CHANNEL-1
SUB-CHANNEL-2
SUB-CHANNEL-3
SUB-CHANNEL-4
740a 740b 740c 740d
742a 742b 742c 742d
SIGNAL POINT CODE WORD "11111111"
741
10 00 01 11
I
Q
1ST LEVEL 4 SEGMENTS
2ND LEVEL 16 SEGMENTS
3RD LEVEL 64 SEGMENTS
4TH LEVEL 256 SEGMENTS

FIG. 110

FIG. 111

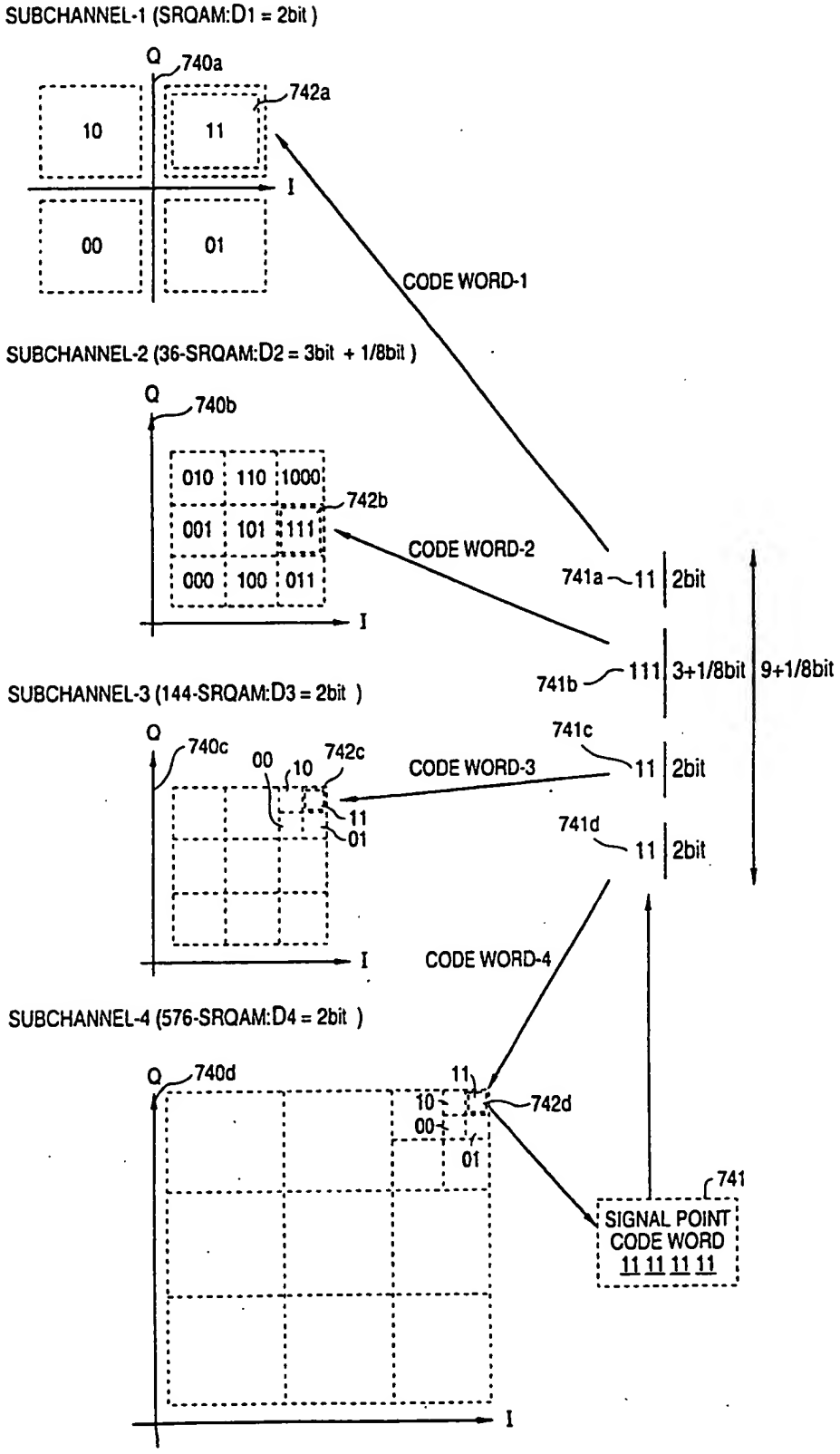
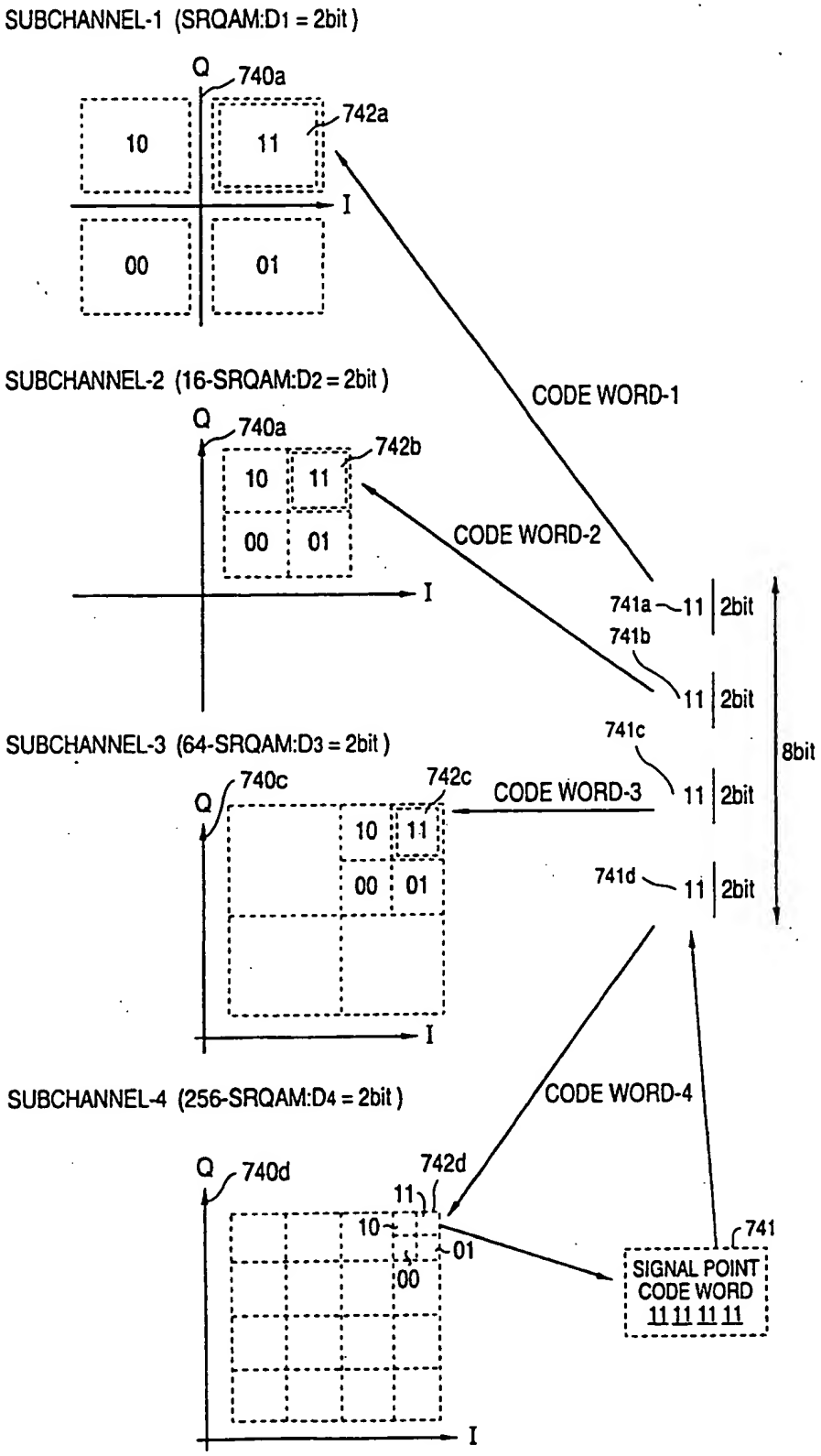

SUBCHANNEL-1 (SRQAM:D1 = 2bit)
Q
740a
742a
10
11
I
00
01
CODE WORD-1
SUBCHANNEL-2 (36-SRQAM:D2 = 3bit + 1/8bit)
Q
740b
010
110
1000
742b
001
101
111
000
100
011
I
CODE WORD-2
741a
11
2bit
741b
111
3+1/8bit
9+1/8bit
SUBCHANNEL-3 (144-SRQAM:D3 = 2bit)
Q
740c
00
10
742c
11
01
I
CODE WORD-3
741c
11
2bit
741d
11
2bit
CODE WORD-4
SUBCHANNEL-4 (576-SRQAM:D4 = 2bit)
Q
740d
11
10
00
742d
01
741
SIGNAL POINT
CODE WORD
11 11 11 11
I

FIG. 112


SUBCHANNEL-1 (SRQAM:D1 = 2bit)
Q
740a
742a
10
11
I
00
01
CODE WORD-1
SUBCHANNEL-2 (16-SRQAM:D2 = 2bit)
Q
740a
742b
10
11
00
01
I
CODE WORD-2
741a
11
2bit
741b
11
2bit
741c
11
2bit
8bit
SUBCHANNEL-3 (64-SRQAM:D3 = 2bit)
740c
742c
CODE WORD-3
Q
10
11
00
01
I
741d
11
2bit
CODE WORD-4
SUBCHANNEL-4 (256-SRQAM:D4 = 2bit)
Q
740d
742d
11
10
01
00
I
741
SIGNAL POINT
CODE WORD
11 11 11 11

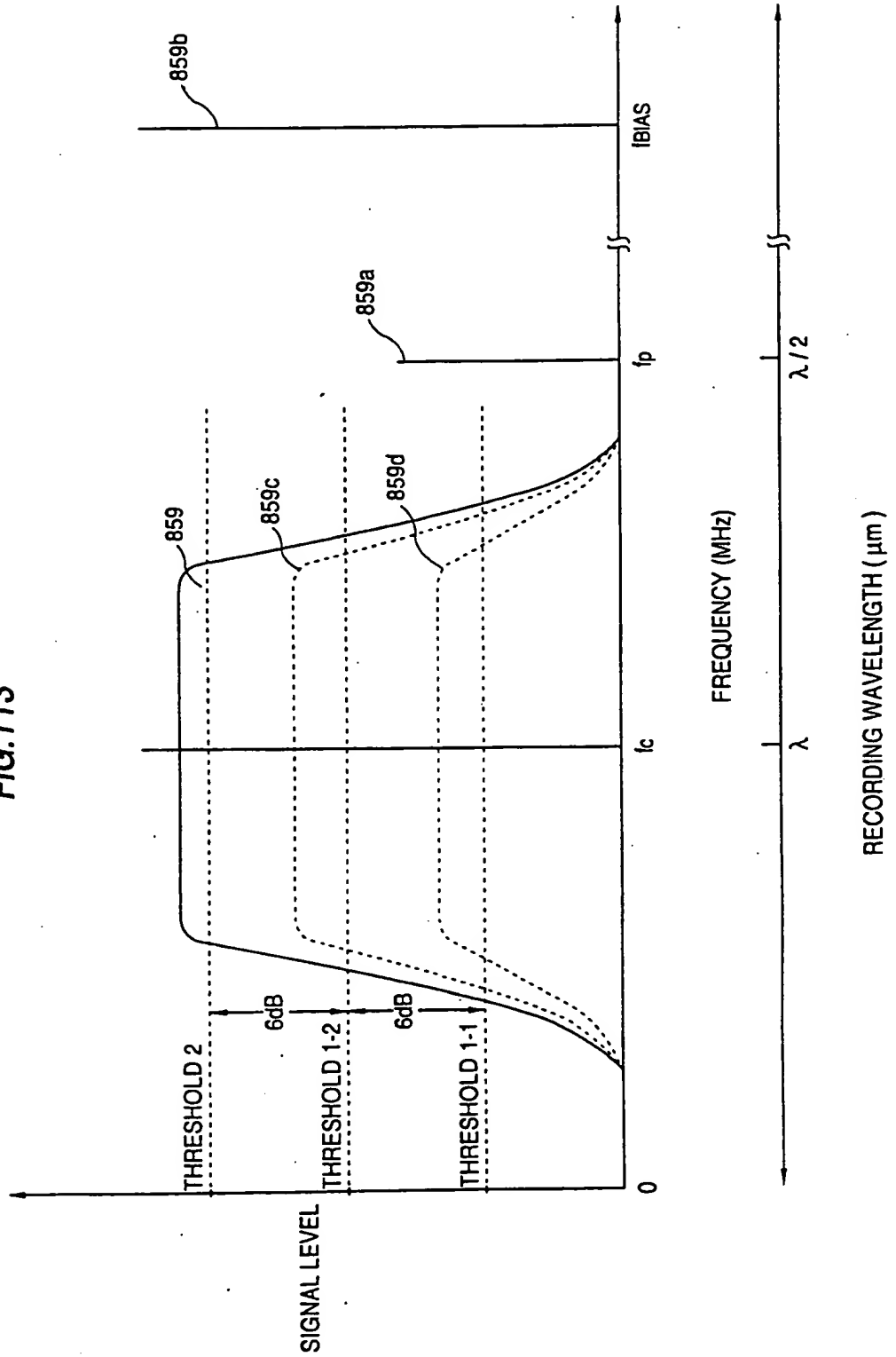

859b
IBIAS
859a
fp
859
859c
859d
fc
6dB
6dB
THRESHOLD 2
THRESHOLD 1-2
THRESHOLD 1-1
0
SIGNAL LEVEL
FREQUENCY (MHz)
λ/2
λ
RECORDING WAVELENGTH (μm)

FIG.113

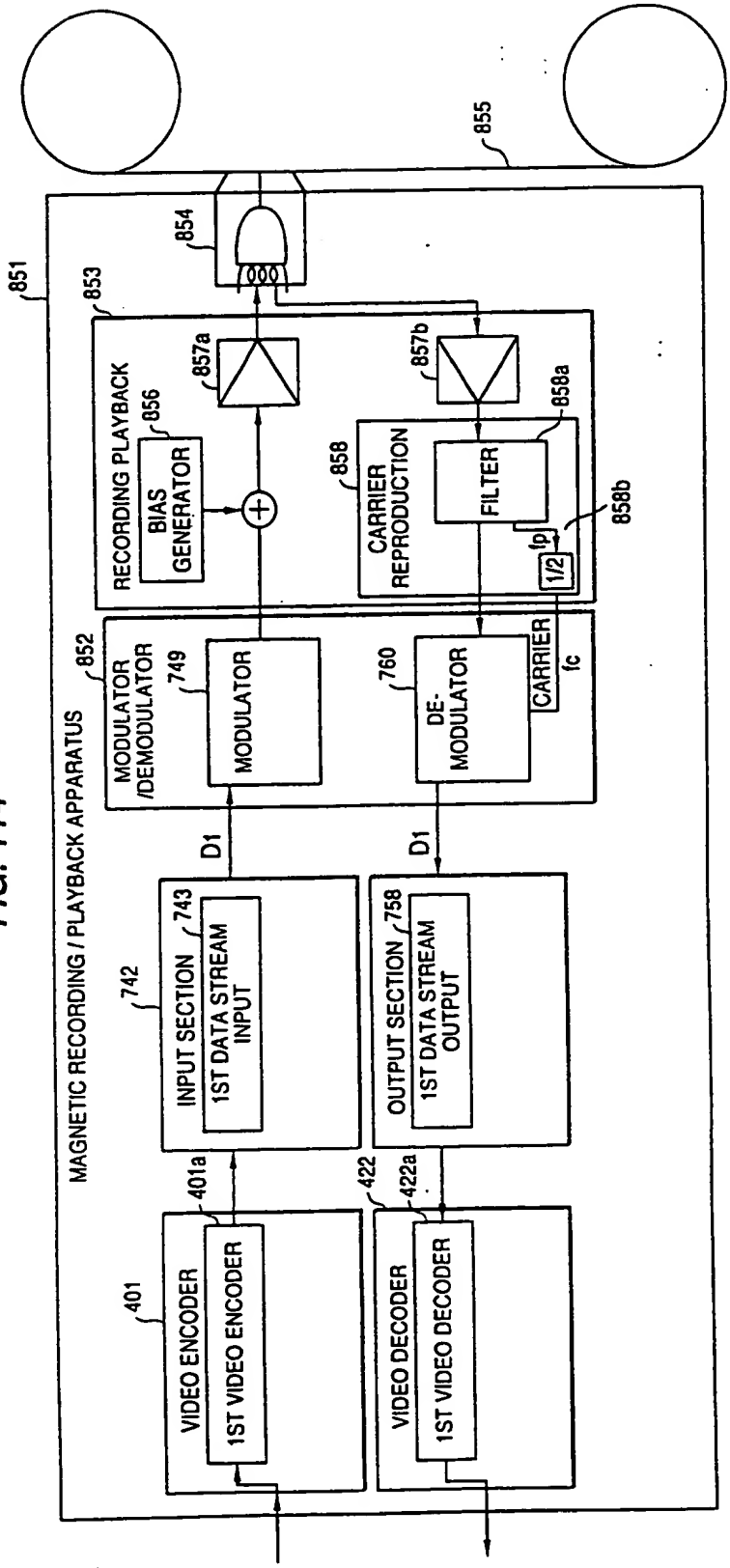

855
854
851
853
RECORDING PLAYBACK
856
BIAS GENERATOR
857a
857b
858a
858
CARRIER REPRODUCTION
FILTER
858b
1p
1/2
MODULATOR /DEMODULATOR
852
749
MODULATOR
760
DE-MODULATOR
CARRIER
fc
D1
D1
MAGNETIC RECORDING / PLAYBACK APPARATUS
INPUT SECTION
743
1ST DATA STREAM INPUT
742
OUTPUT SECTION
758
1ST DATA STREAM OUTPUT
401a
422
422a
VIDEO ENCODER
1ST VIDEO ENCODER
401
VIDEO DECODER
1ST VIDEO DECODER

FIG. 114

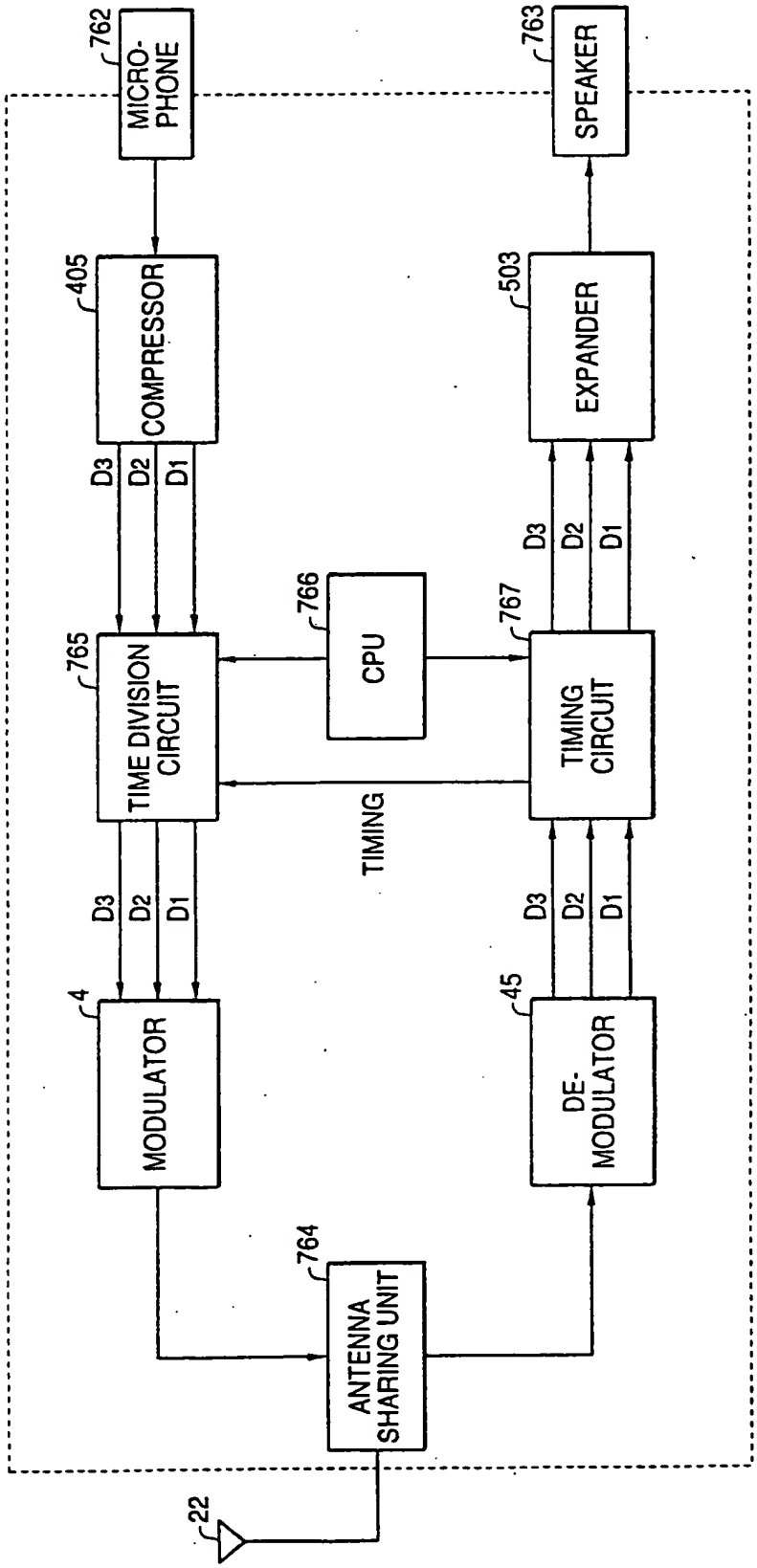

762
MICRO-PHONE
763
SPEAKER
405
COMPRESSOR
503
EXPANDER
D3
D2
D1
766
CPU
767
765
TIME DIVISION CIRCUIT
TIMING CIRCUIT
TIMING
4
MODULATOR
45
DE-MODULATOR
764
ANTENNA SHARING UNIT
22

FIG. 115

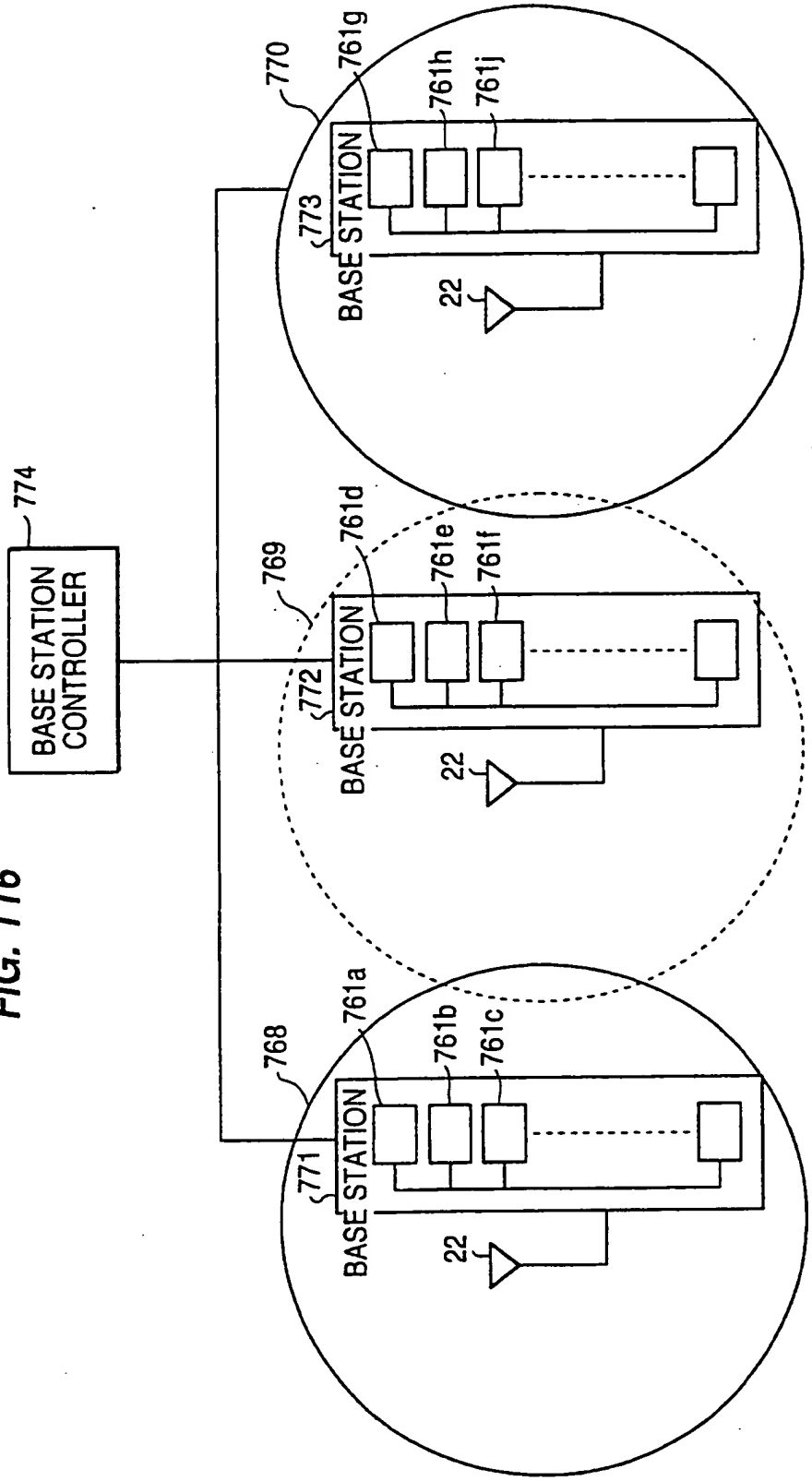

BASE STATION CONTROLLER
774
BASE STATION
770
761g
761h
761j
773
22
BASE STATION
769
761d
761e
761f
772
22
BASE STATION
768
761a
761b
761c
771
22

FIG. 116

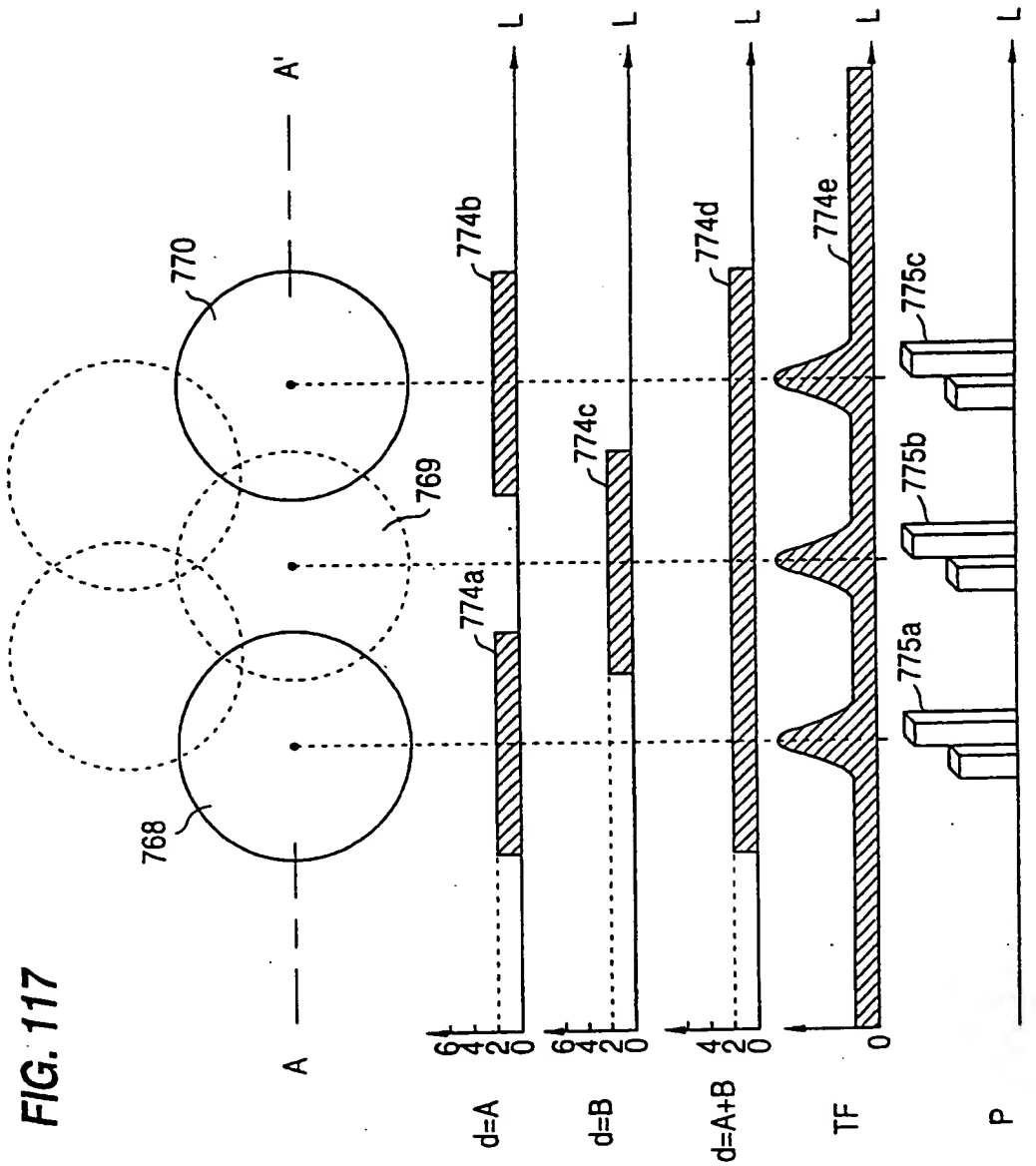

A
A'
768
769
770
774a
774b
774c
774d
774e
775a
775b
775c
L
6
4
2
0
d=A
d=B
d=A+B
TF
P

FIG. 117

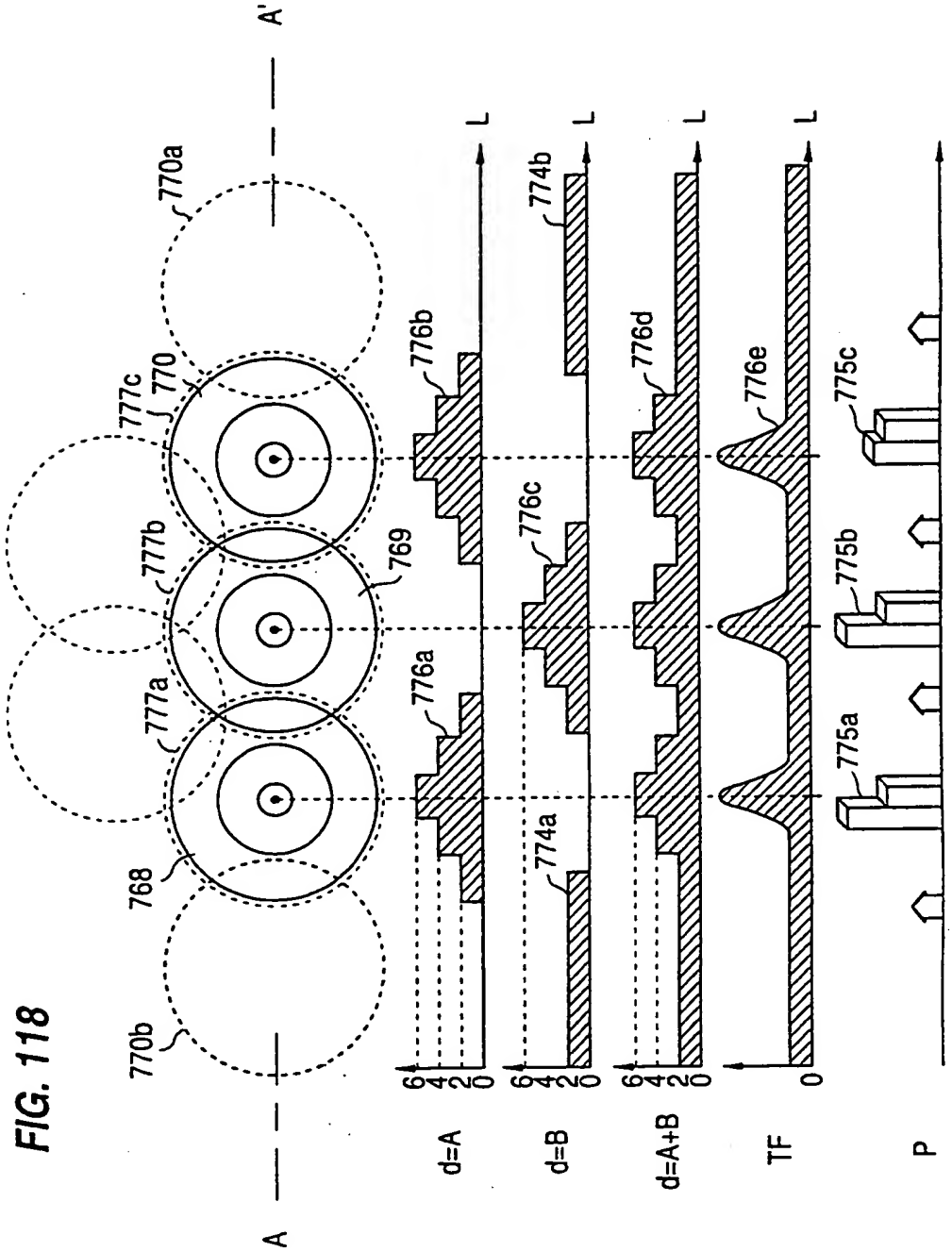

A
A'
770a
770
770b
777c
777b
777a
768
769
776a
776b
776c
776d
776e
774a
774b
775a
775b
775c
L
6
4
2
0
d=A
d=B
d=A+B
TF
P

FIG. 118

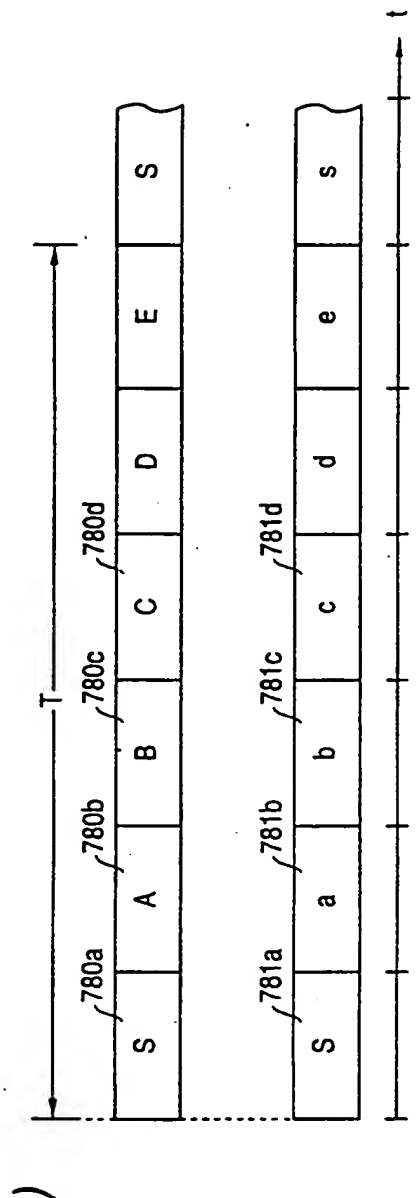


FIG. 119(a)

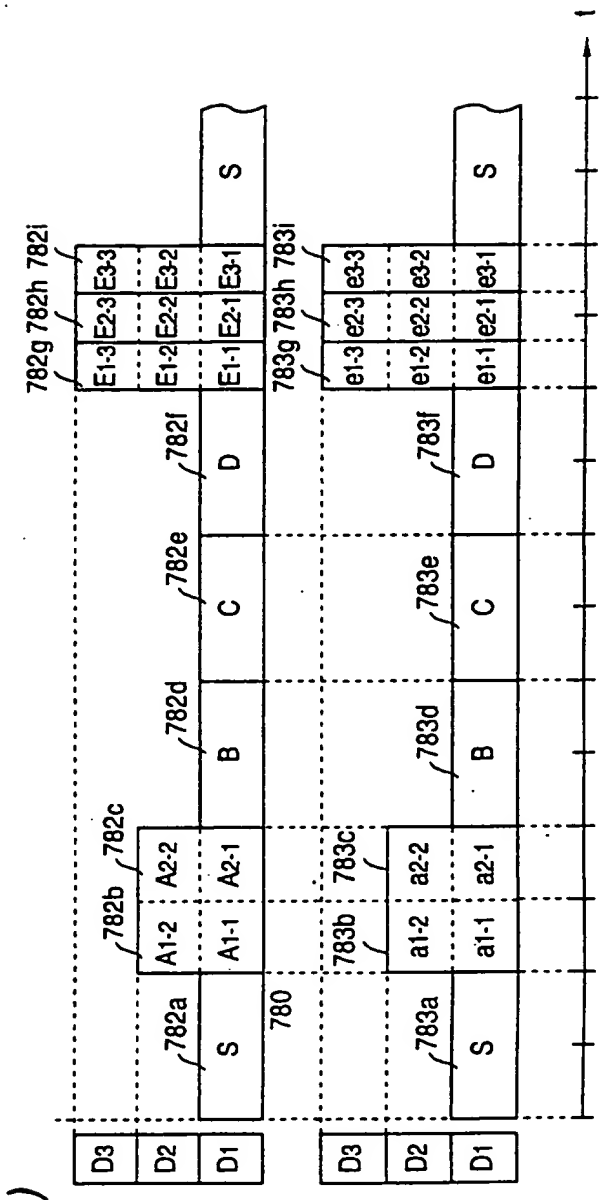


FIG. 119(b)

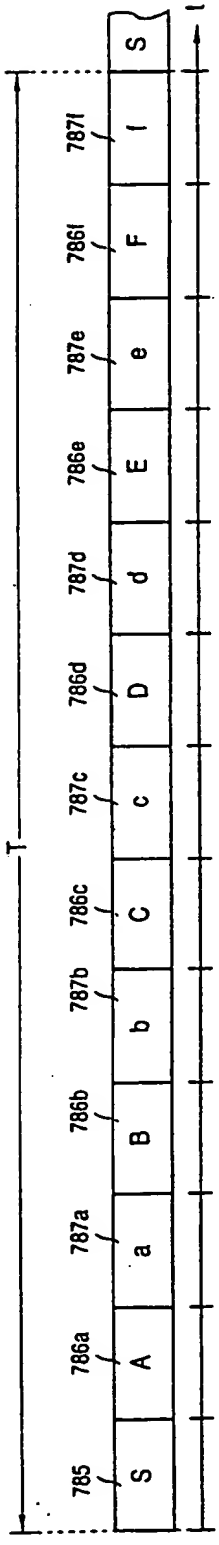


FIG. 120(a)

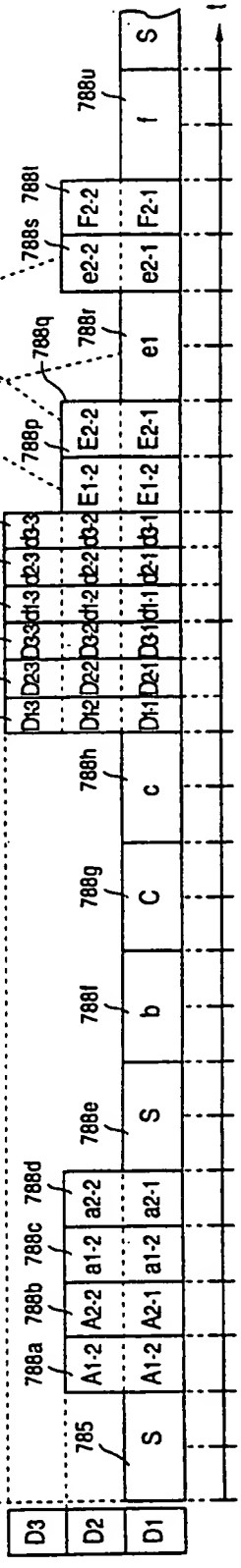


FIG. 120(b)

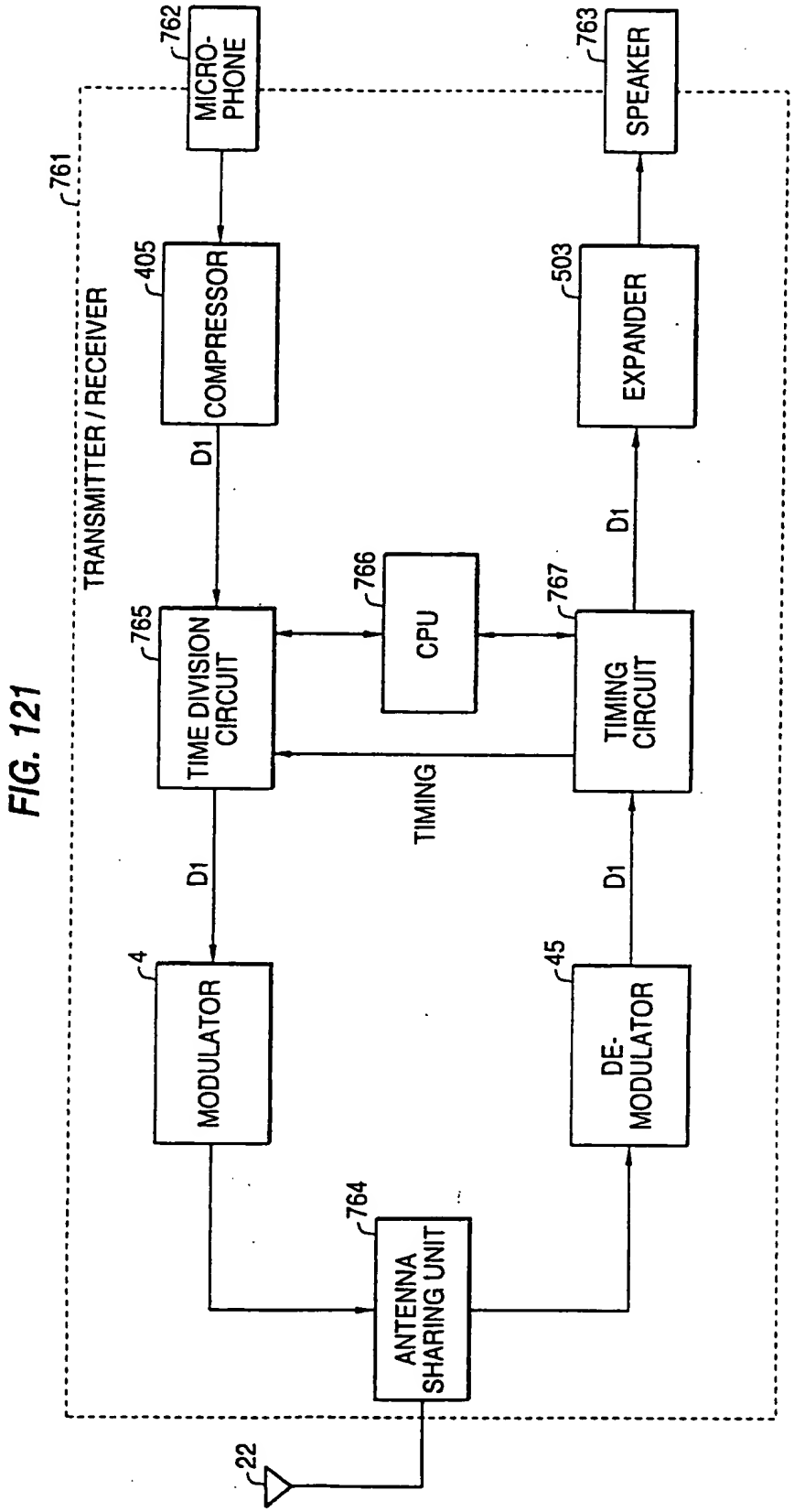

762
MICRO-PHONE
763
SPEAKER
761
TRANSMITTER / RECEIVER
405
COMPRESSOR
503
EXPANDER
D1
D1
766
CPU
767
765
TIME DIVISION CIRCUIT
TIMING CIRCUIT
TIMING
D1
D1
4
MODULATOR
45
DE-MODULATOR
764
ANTENNA SHARING UNIT
22

FIG. 121

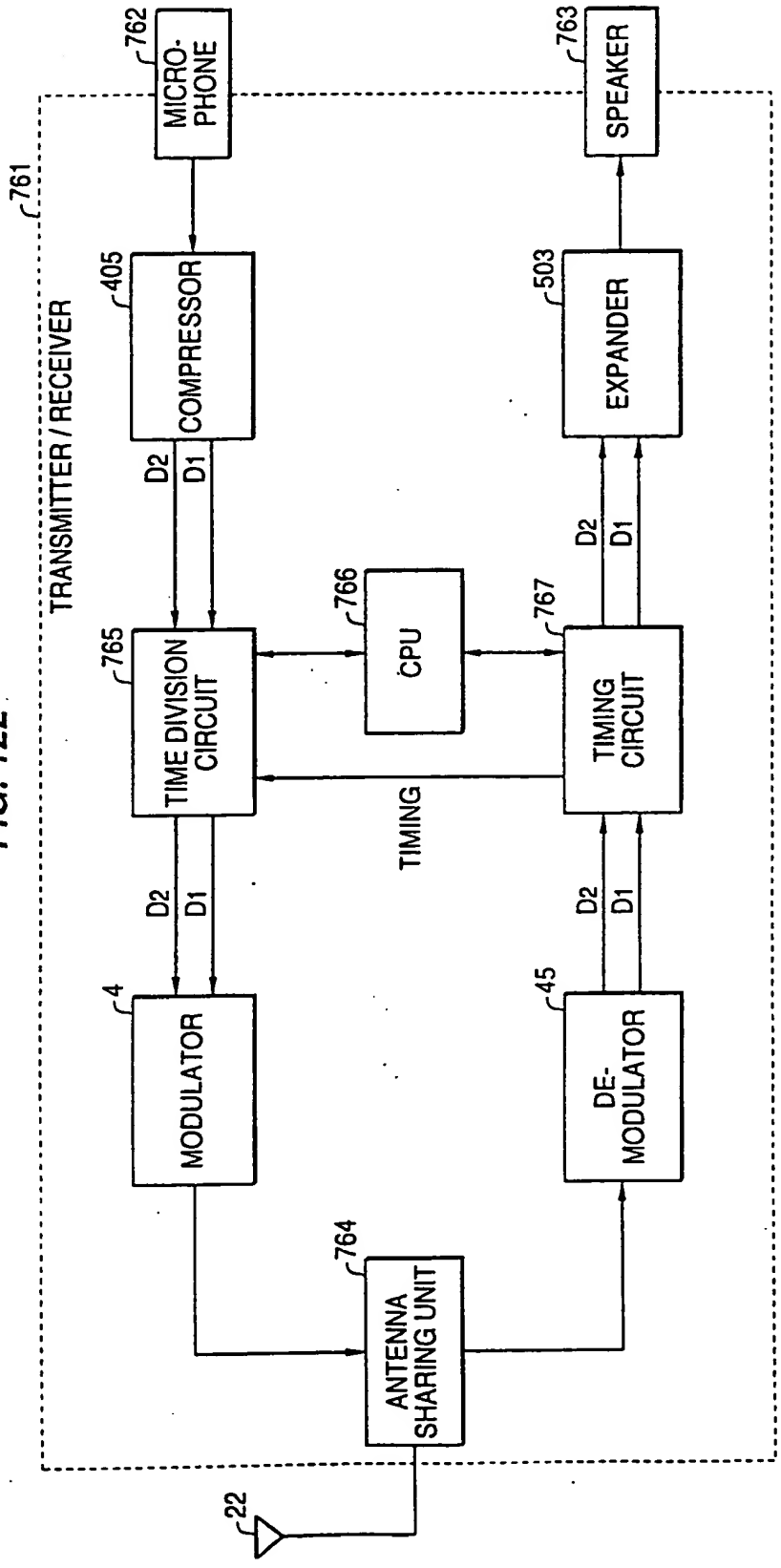

762
MICRO-PHONE
763
SPEAKER
761
TRANSMITTER / RECEIVER
405
COMPRESSOR
503
EXPANDER
D2
D1
D2
D1
766
CPU
765
TIME DIVISION CIRCUIT
767
TIMING CIRCUIT
TIMING
D2
D1
D2
D1
4
MODULATOR
45
DE-MODULATOR
764
ANTENNA SHARING UNIT
22

FIG. 122

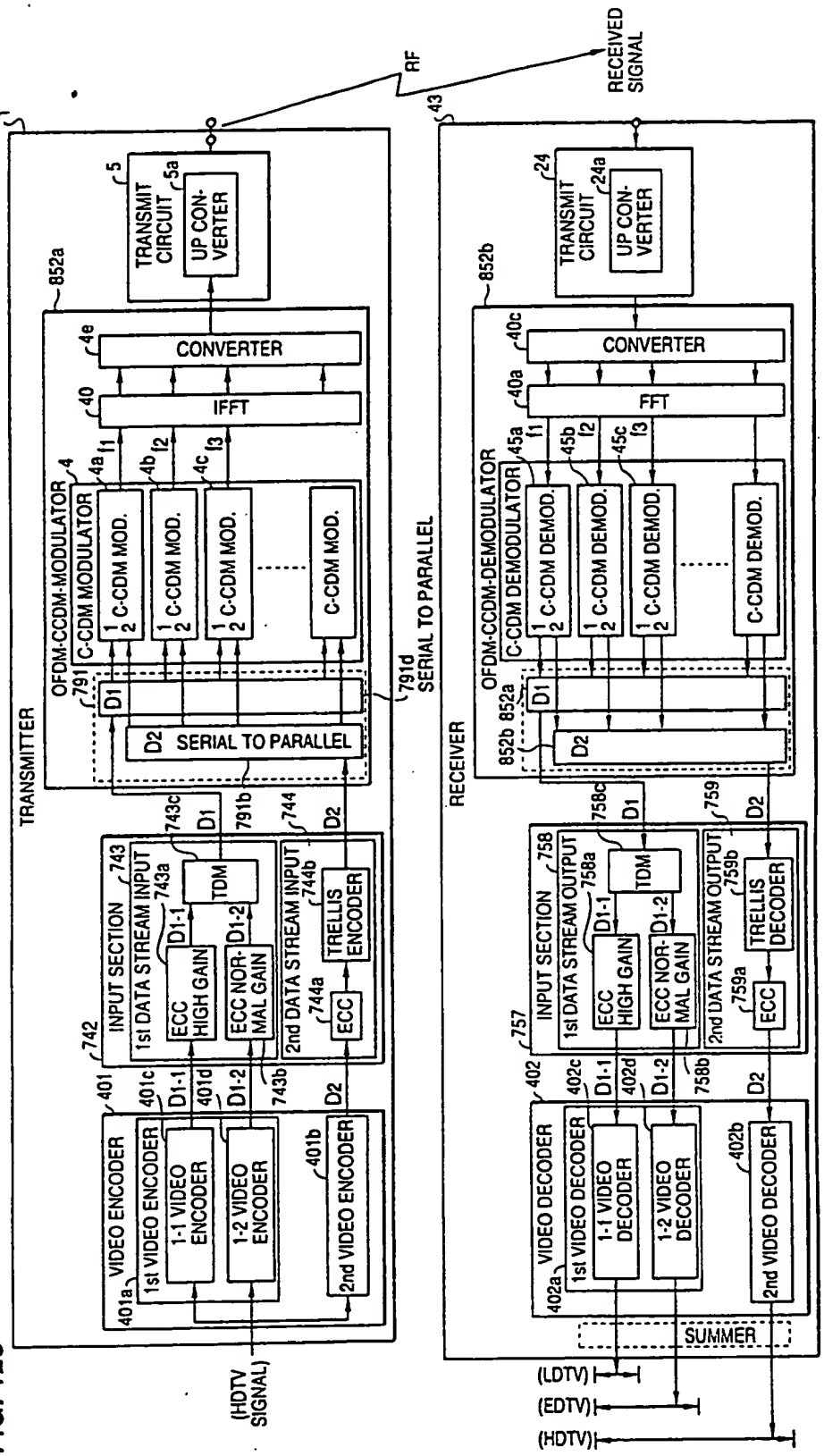

TRANSMITTER
RECEIVER
RF
RECEIVED SIGNAL
SERIAL TO PARALLEL
TRANSMIT CIRCUIT
UP CONVERTER
CONVERTER
IFFT
FFT
OFDM-CCDM-MODULATOR
C-CDM MODULATOR
C-CDM MOD.
OFDM-CCDM-DEMODULATOR
C-CDM DEMODULATOR
C-CDM DEMOD.
SERIAL TO PARALLEL
INPUT SECTION
1st DATA STREAM INPUT
2nd DATA STREAM INPUT
ECC
HIGH GAIN
ECC NOR-MAL GAIN
TDM
TRELLIS ENCODER
TRELLIS DECODER
VIDEO ENCODER
1st VIDEO ENCODER
1-1 VIDEO ENCODER
1-2 VIDEO ENCODER
2nd VIDEO ENCODER
VIDEO DECODER
1st VIDEO DECODER
1-1 VIDEO DECODER
1-2 VIDEO DECODER
2nd VIDEO DECODER
SUMMER
(HDTV SIGNAL)
(LDTV)
(EDTV)
(HDTV)

FIG. 123

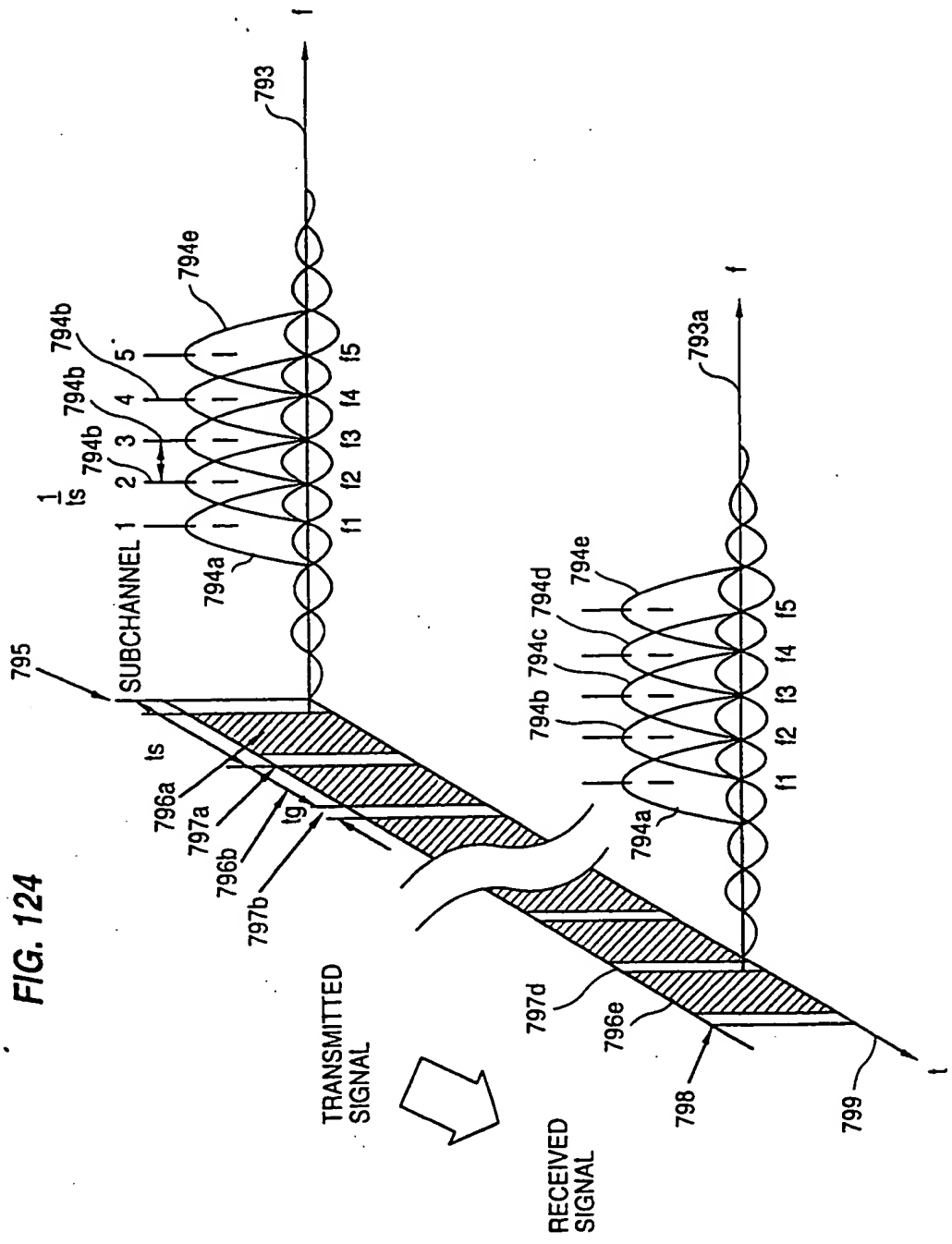

795
SUBCHANNEL 1
1/ts
2
3
4
5
794a
794b
794e
793
f1 f2 f3 f4 f5
ts
796a
797a
796b
797b
tg
TRANSMITTED SIGNAL
RECEIVED SIGNAL
794a
794b 794c 794d
794e
793a
797d
796e
798
799
f

FIG. 124

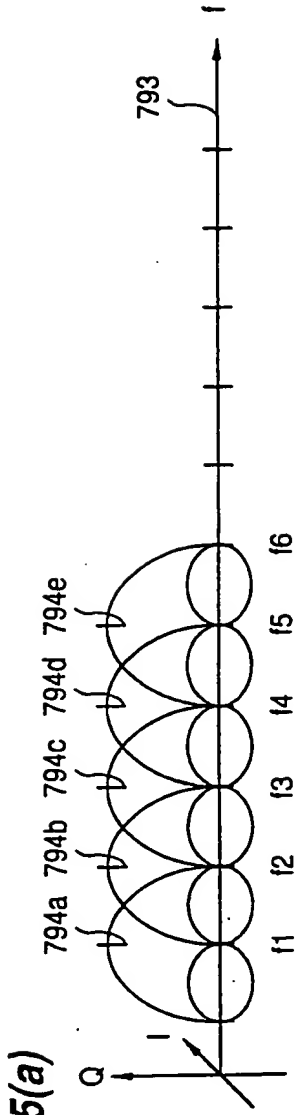


FIG. 125(a)

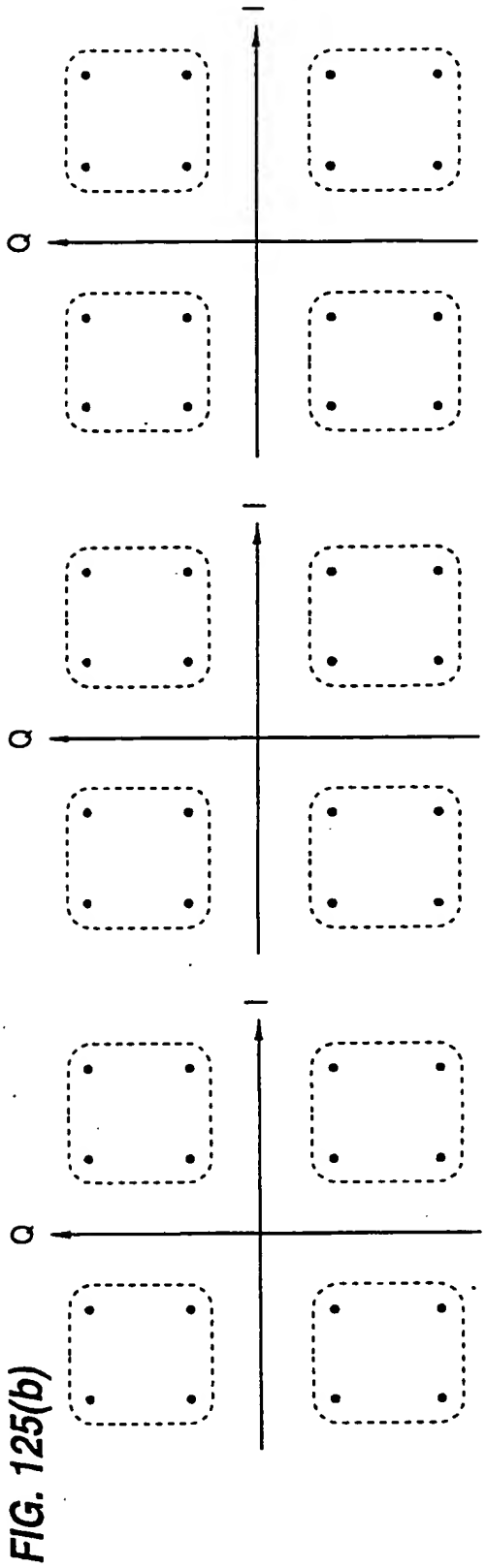


FIG. 125(b)

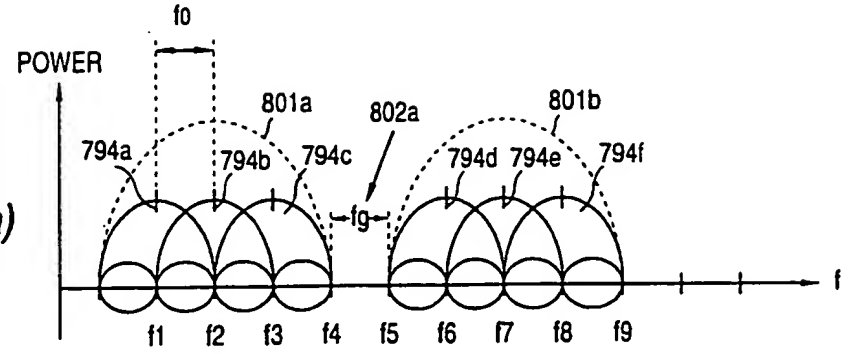


FIG. 126(a)

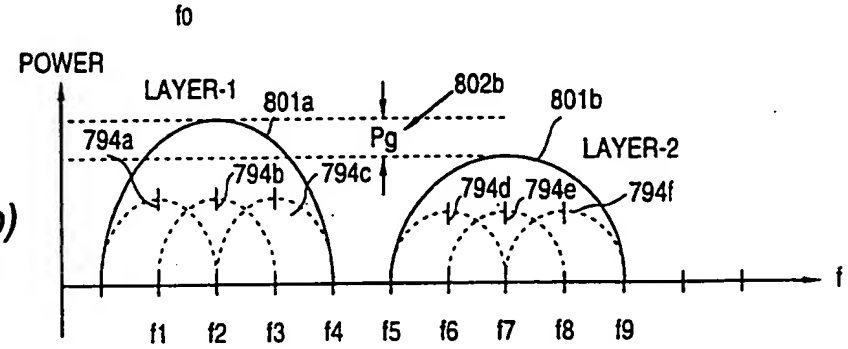


FIG. 126(b)

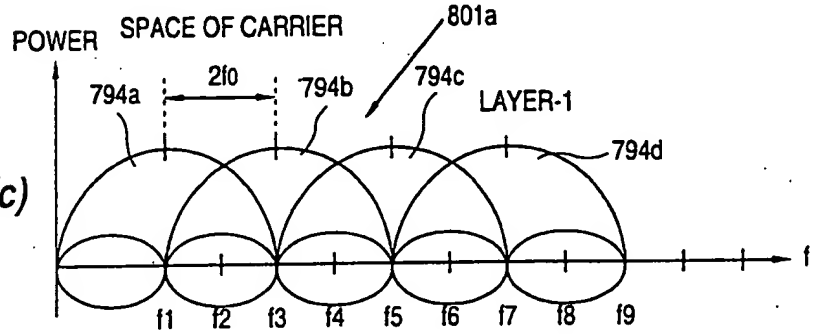


FIG. 126(c)

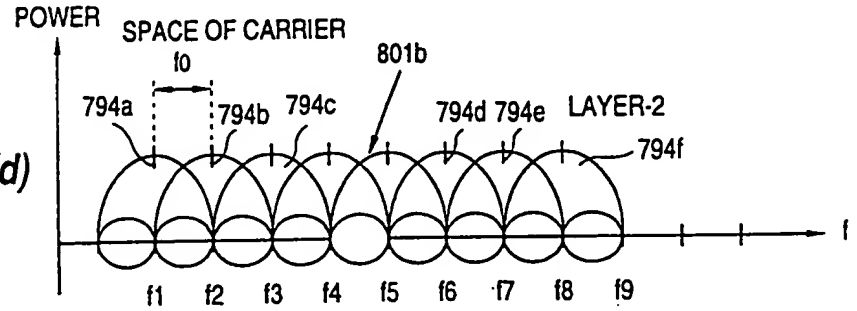


FIG. 126(d)

FIG. 127

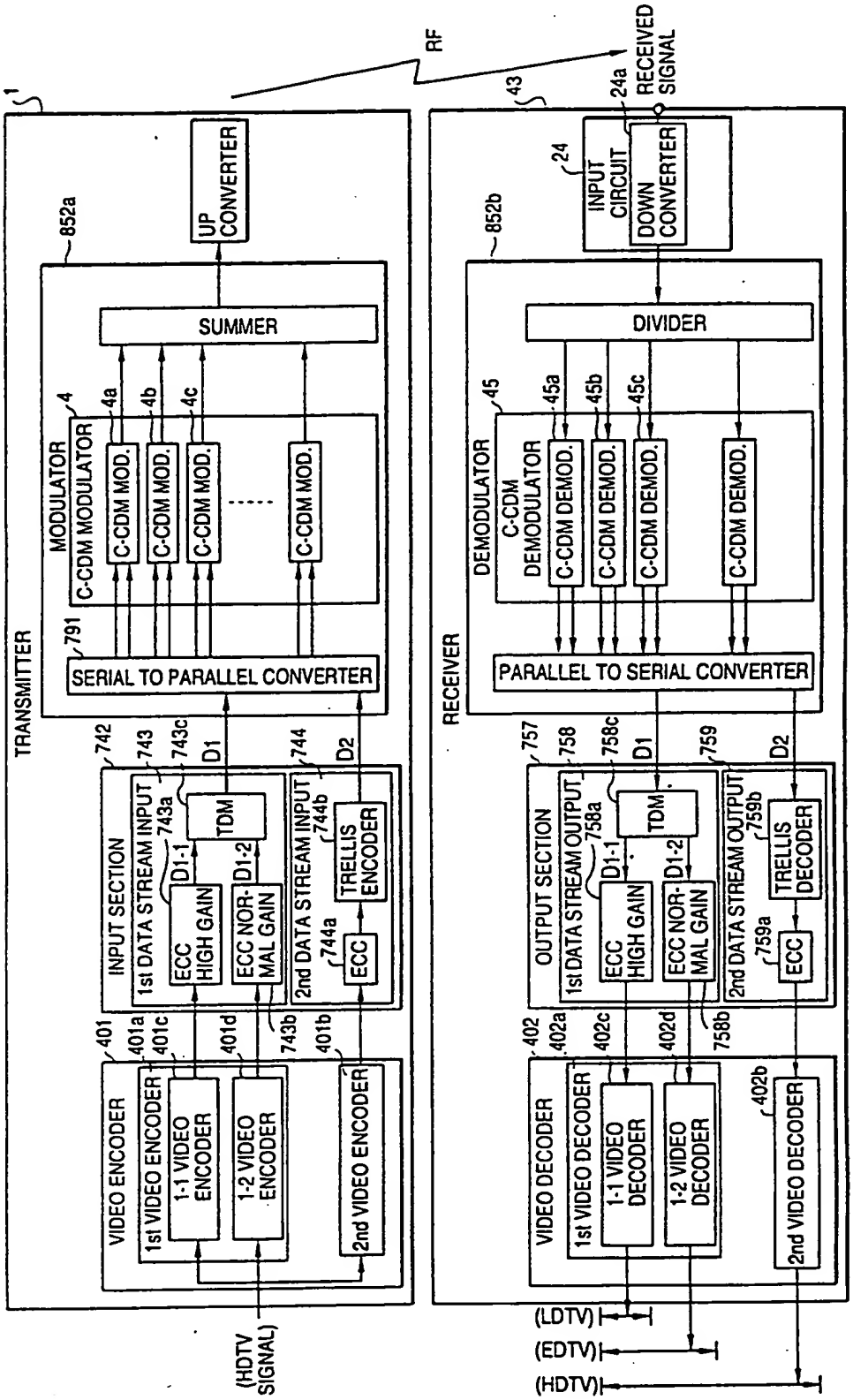

TRANSMITTER
RECEIVER
RF
RECEIVED SIGNAL
UP CONVERTER
INPUT CIRCUIT
DOWN CONVERTER
SUMMER
DIVIDER
MODULATOR
C-CDM MODULATOR
C-CDM MOD.
DEMODULATOR
C-CDM DEMODULATOR
C-CDM DEMOD.
SERIAL TO PARALLEL CONVERTER
PARALLEL TO SERIAL CONVERTER
INPUT SECTION
1st DATA STREAM INPUT
2nd DATA STREAM INPUT
OUTPUT SECTION
1st DATA STREAM OUTPUT
2nd DATA STREAM OUTPUT
ECC HIGH GAIN
ECC NORMAL GAIN
TDM
TRELLIS ENCODER
TRELLIS DECODER
ECC
VIDEO ENCODER
1st VIDEO ENCODER
1-1 VIDEO ENCODER
1-2 VIDEO ENCODER
2nd VIDEO ENCODER
VIDEO DECODER
1st VIDEO DECODER
1-1 VIDEO DECODER
1-2 VIDEO DECODER
2nd VIDEO DECODER
(HDTV SIGNAL)
(LDTV)
(EDTV)
(HDTV)

FIG. 128(a)

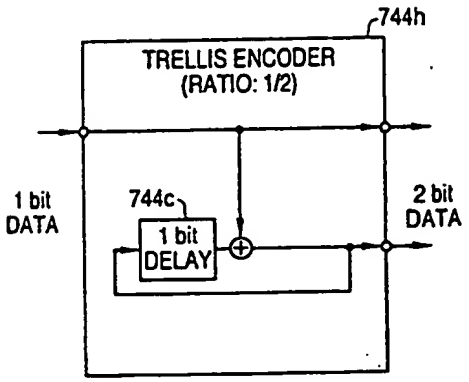


FIG. 128(b)

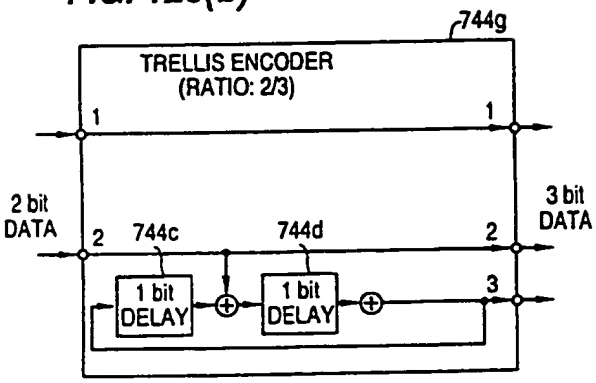


FIG. 128(c)

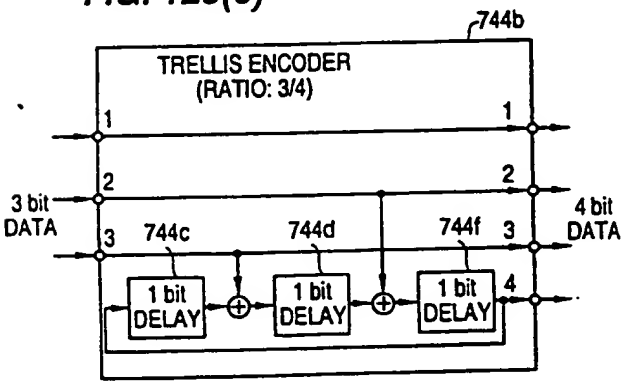


FIG. 128(d)

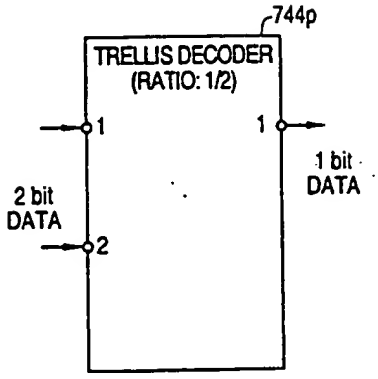


FIG. 128(e)

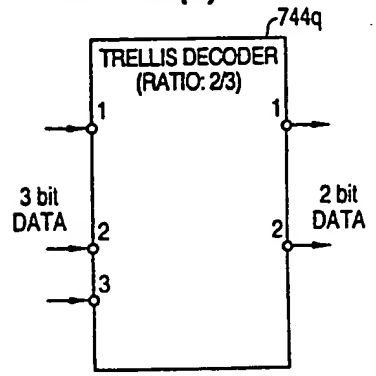
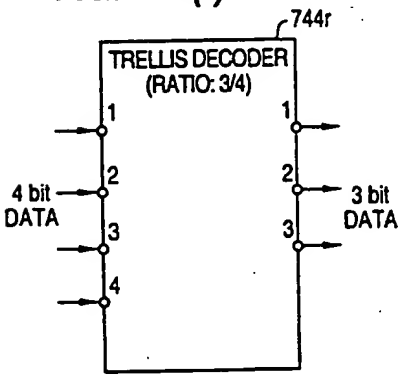


FIG. 128(f)



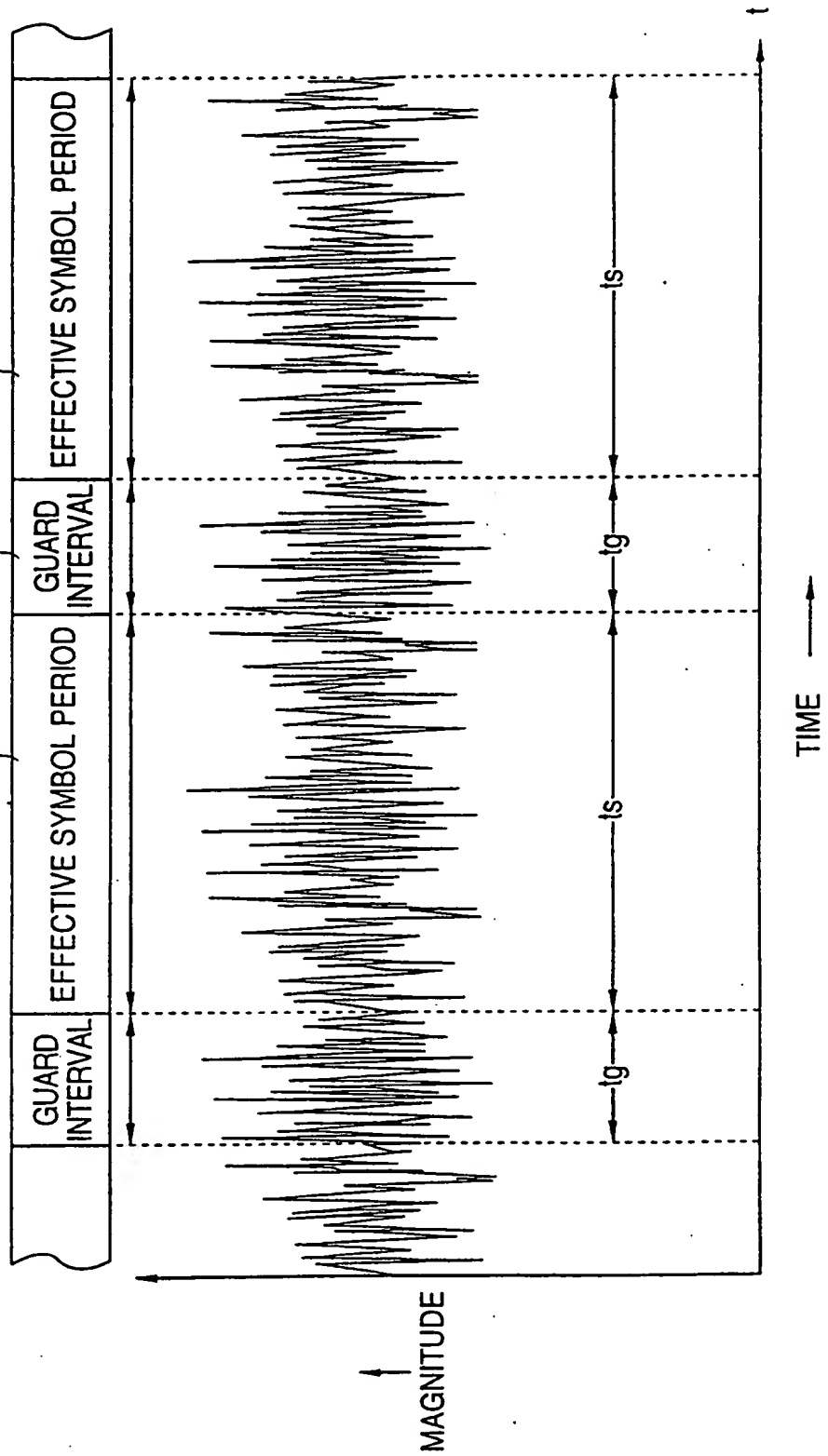
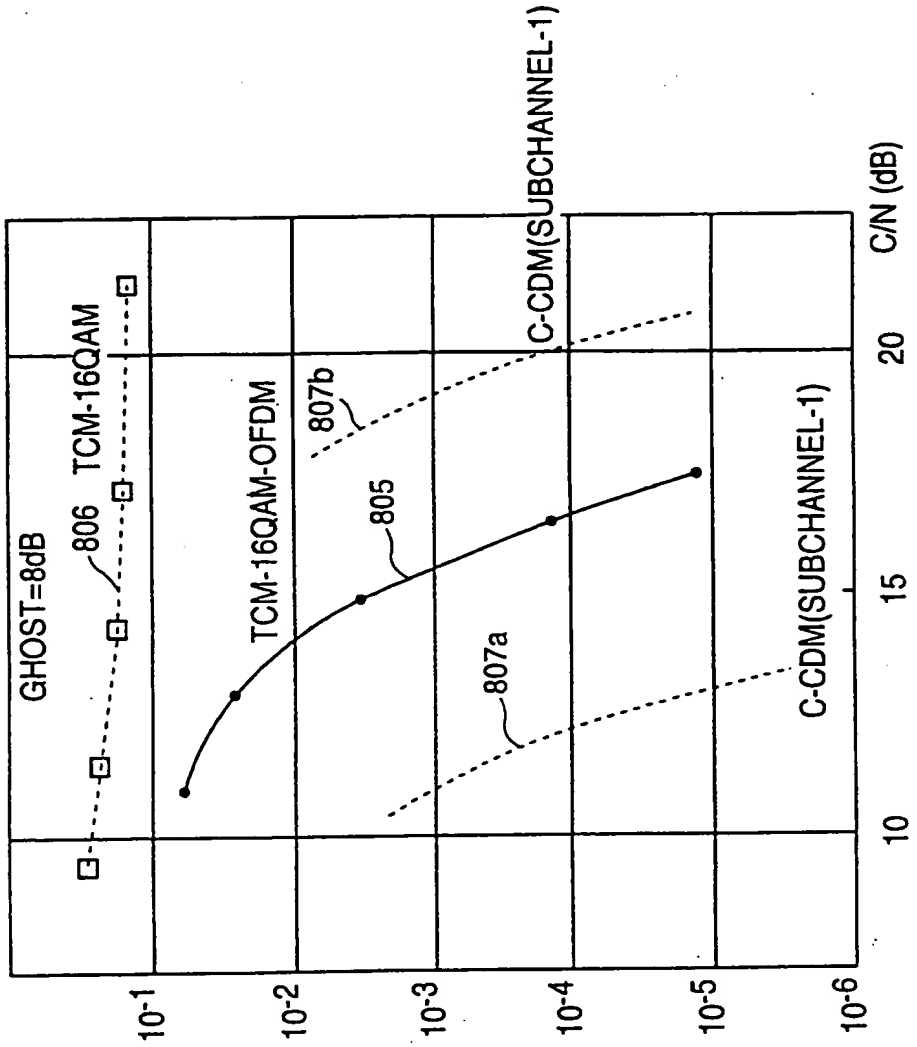

796b
EFFECTIVE SYMBOL PERIOD
797a
GUARD INTERVAL
796a
EFFECTIVE SYMBOL PERIOD
GUARD INTERVAL
ts
tg
ts
tg
TIME
MAGNITUDE

FIG. 129

FIG. 130


GHOST=8dB
806
TCM-16QAM
TCM-16QAM-OFDM
805
807b
C-CDM(SUBCHANNEL-1)
807a
C-CDM(SUBCHANNEL-1)
10
15
20
C/N (dB)
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}

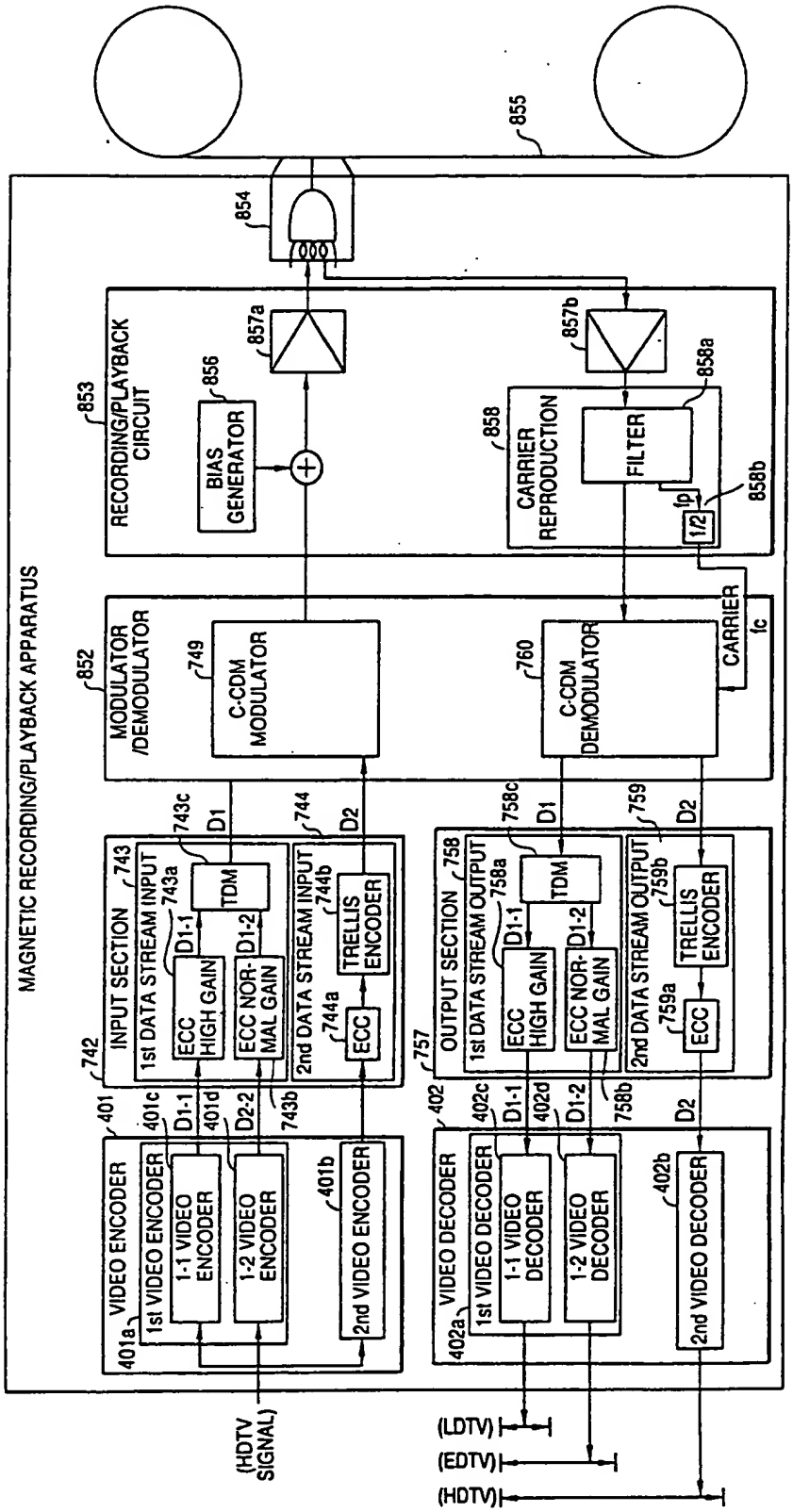

MAGNETIC RECORDING/PLAYBACK APPARATUS
855
854
RECORDING/PLAYBACK CIRCUIT
853
857a
857b
856
BIAS GENERATOR
858
CARRIER REPRODUCTION
858a
FILTER
858b
1/2
MODULATOR /DEMODULATOR
852
749
C-CDM MODULATOR
760
C-CDM DEMODULATOR
CARRIER
1c
INPUT SECTION
743
1st DATA STREAM INPUT
743a
743c
D1
2nd DATA STREAM INPUT
744b
744
D2
ECC HIGH GAIN
ECC NOR-MAL GAIN
TDM
TRELLIS ENCODER
744a
ECC
742
OUTPUT SECTION
758
1st DATA STREAM OUTPUT
758a
758c
2nd DATA STREAM OUTPUT
759b
759
759a
757
VIDEO ENCODER
401
401a
1st VIDEO ENCODER
1-1 VIDEO ENCODER
1-2 VIDEO ENCODER
2nd VIDEO ENCODER
401b
401c
401d
D1-1
D1-2
D2-2
743b
758b
VIDEO DECODER
402
402a
1st VIDEO DECODER
1-1 VIDEO DECODER
1-2 VIDEO DECODER
2nd VIDEO DECODER
402b
402c
402d
D2
(HDTV SIGNAL)
(LDTV)
(EDTV)
(HDTV)

FIG. 131

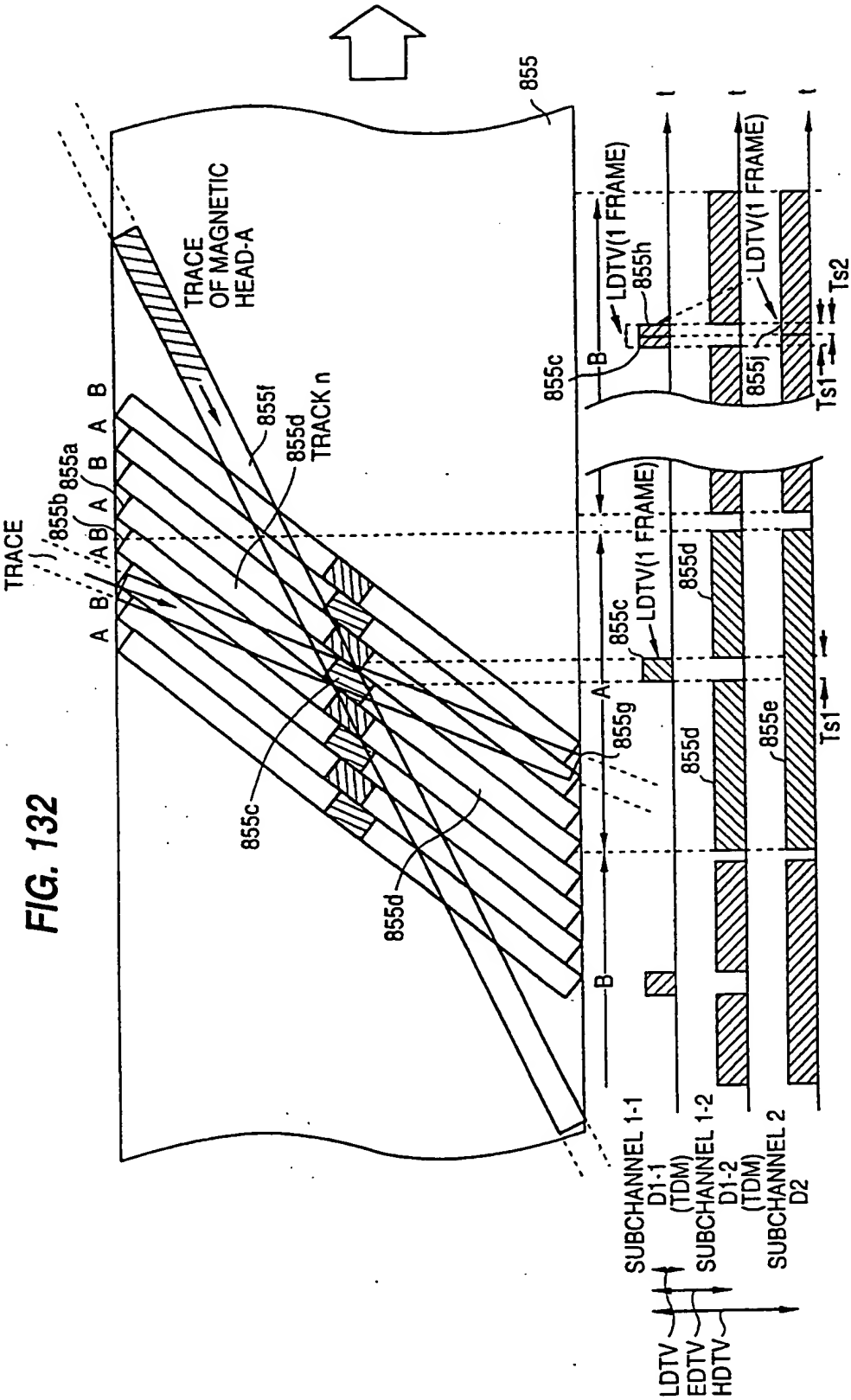

855
TRACE OF MAGNETIC HEAD-A
855f
855d TRACK n
TRACE
855b
855a
A B A B A B
855c
855d
855c
855d
855g
855d
855e
855j
855h
LDTV(1 FRAME)
LDTV(1 FRAME)
LDTV(1 FRAME)
LDTV(1 FRAME)
Ts1
Ts2
Ts1
SUBCHANNEL 1-1 D1-1 (TDM)
SUBCHANNEL 1-2 D1-2 (TDM)
SUBCHANNEL 2 D2
LDTV
EDTV
HDTV

FIG. 132

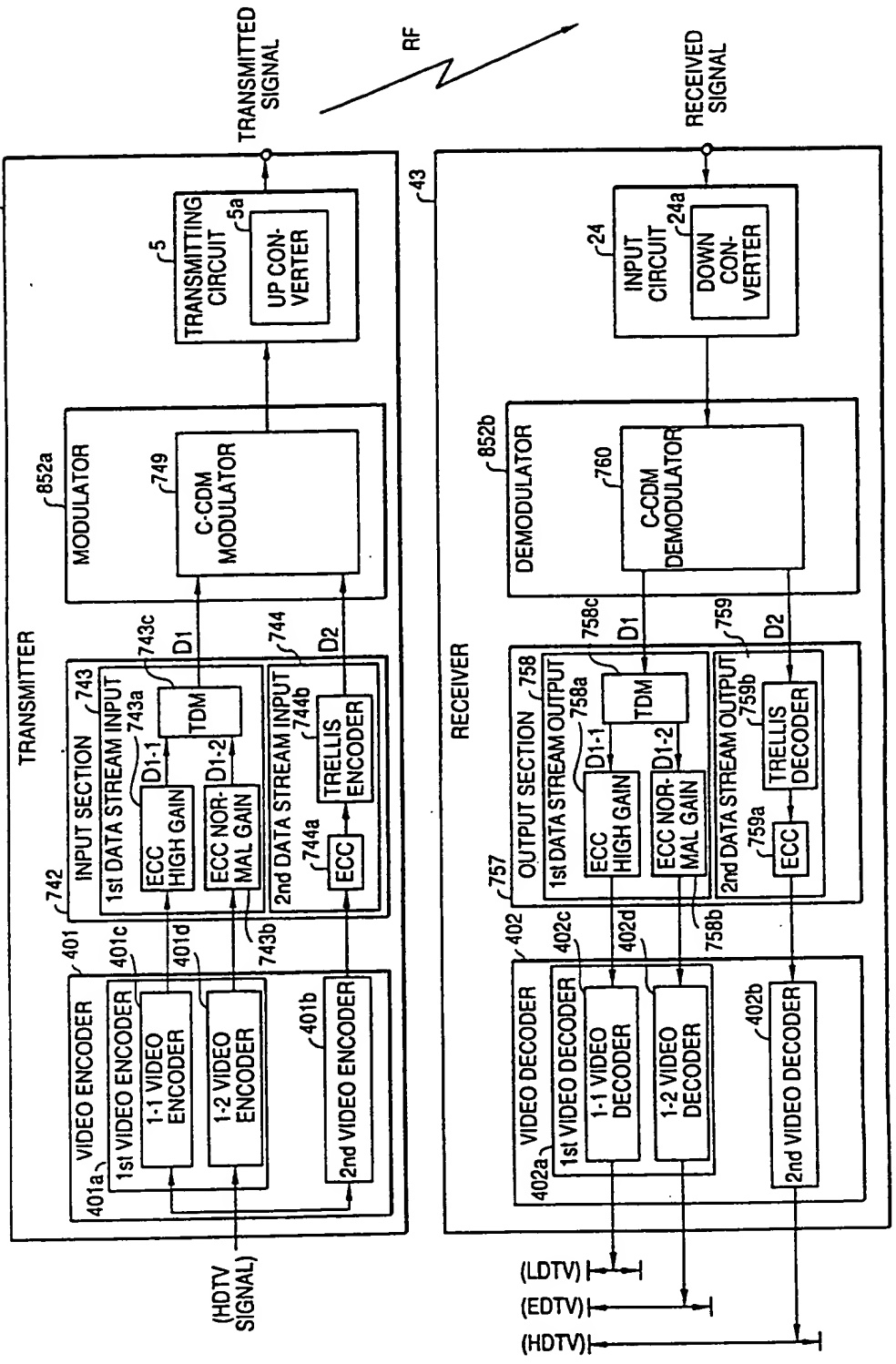

TRANSMITTED SIGNAL
RF
RECEIVED SIGNAL
TRANSMITTER
RECEIVER
MODULATOR
DEMODULATOR
C-CDM MODULATOR
C-CDM DEMODULATOR
TRANSMITTING CIRCUIT
UP CONVERTER
INPUT CIRCUIT
DOWN CONVERTER
INPUT SECTION
1st DATA STREAM INPUT
2nd DATA STREAM INPUT
OUTPUT SECTION
1st DATA STREAM OUTPUT
2nd DATA STREAM OUTPUT
ECC HIGH GAIN
ECC NORMAL GAIN
TDM
TRELLIS ENCODER
TRELLIS DECODER
ECC
VIDEO ENCODER
1st VIDEO ENCODER
1-1 VIDEO ENCODER
1-2 VIDEO ENCODER
2nd VIDEO ENCODER
VIDEO DECODER
1st VIDEO DECODER
1-1 VIDEO DECODER
1-2 VIDEO DECODER
2nd VIDEO DECODER
D1
D2
D1-1
D1-2
(HDTV SIGNAL)
(LDTV)
(EDTV)
(HDTV)

FIG. 133

FIG. 134

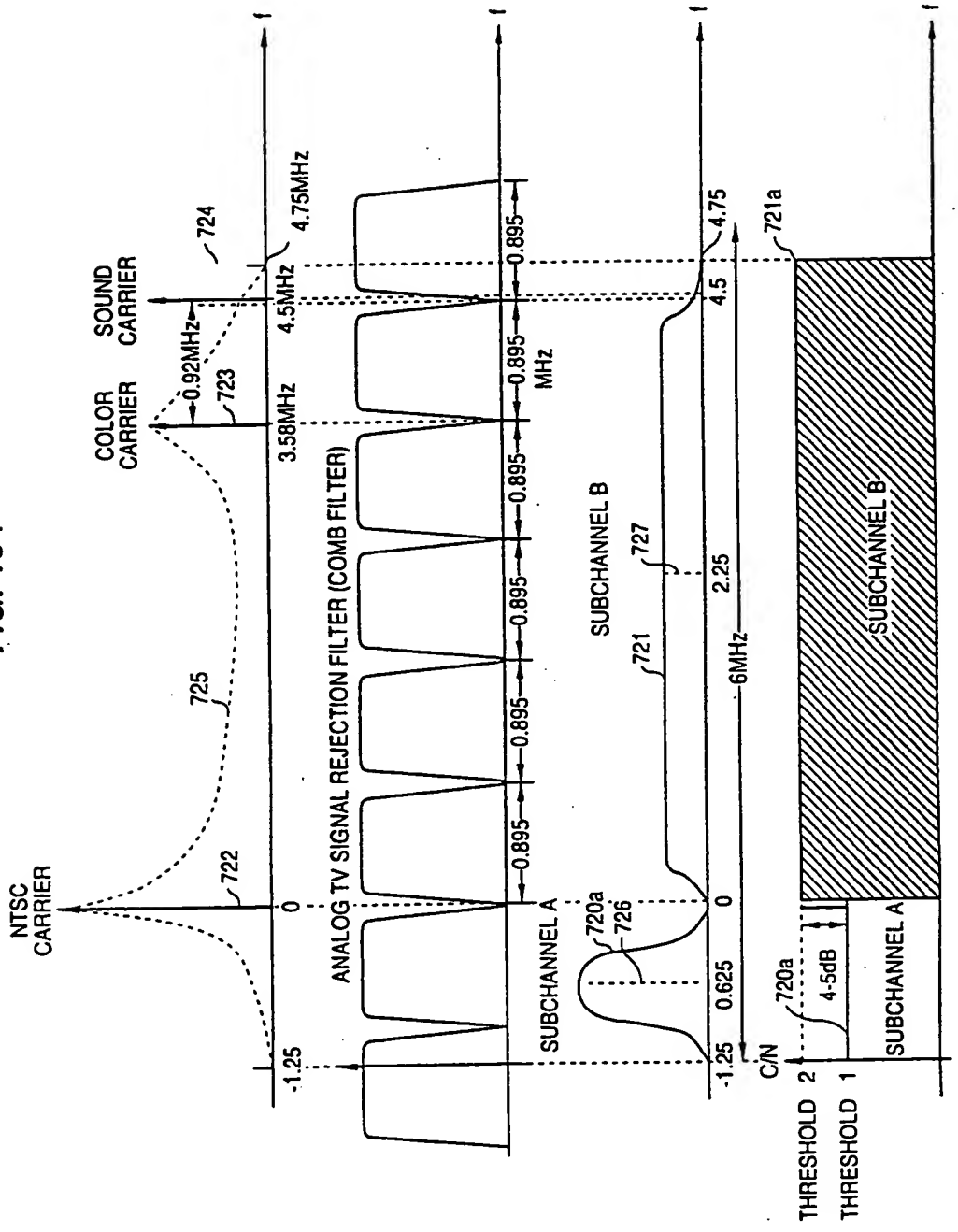

NTSC CARRIER
722
725
COLOR CARRIER
3.58MHz
0.92MHz
723
SOUND CARRIER
724
4.5MHz
4.75MHz
ANALOG TV SIGNAL REJECTION FILTER (COMB FILTER)
0.895
MHz
SUBCHANNEL A
SUBCHANNEL B
720a
726
721
727
721a
4.75
4.5
2.25
6MHz
0
0.625
-1.25
C/N
4-5dB
THRESHOLD 2
THRESHOLD 1

FIG. 135

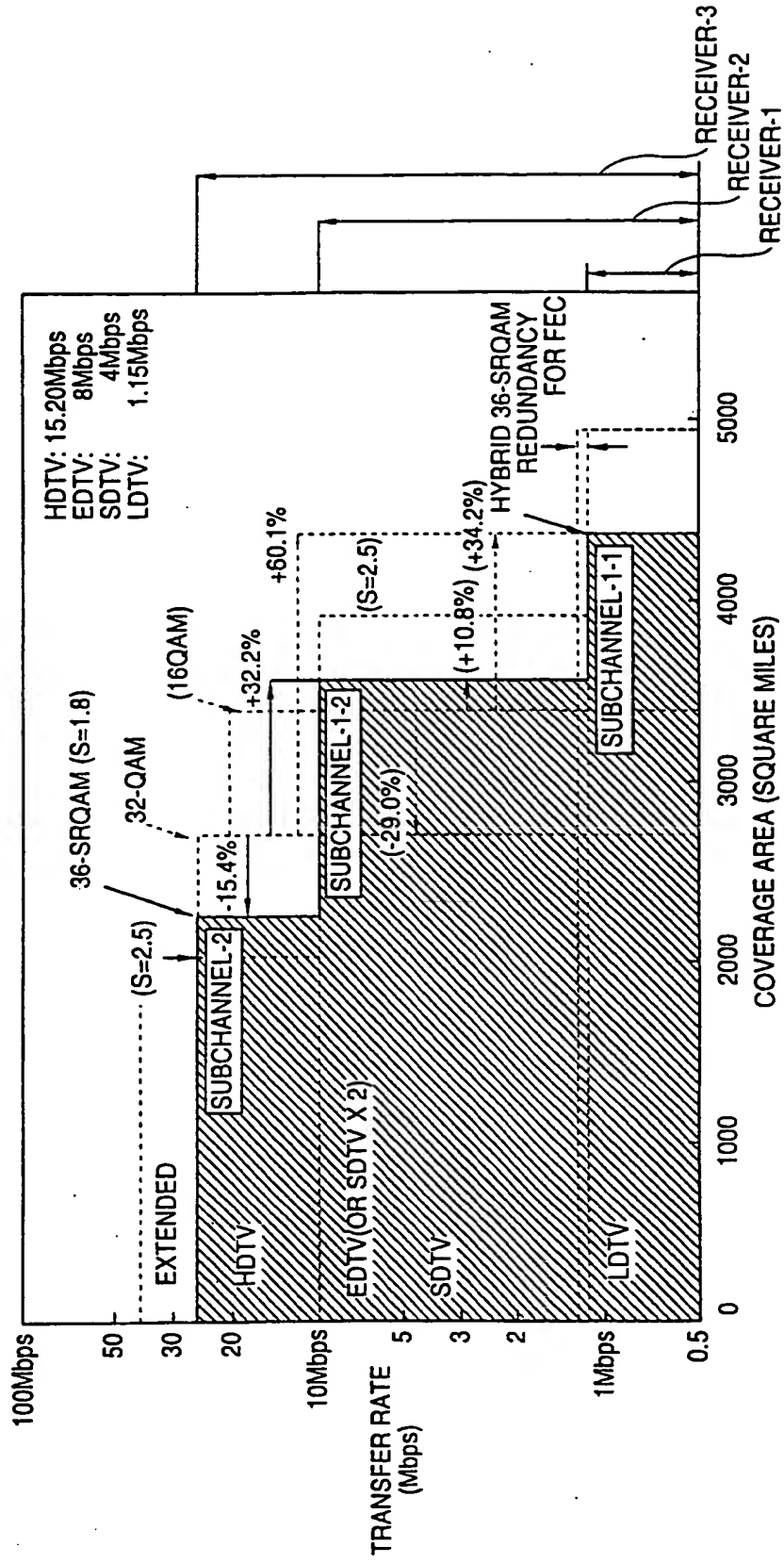
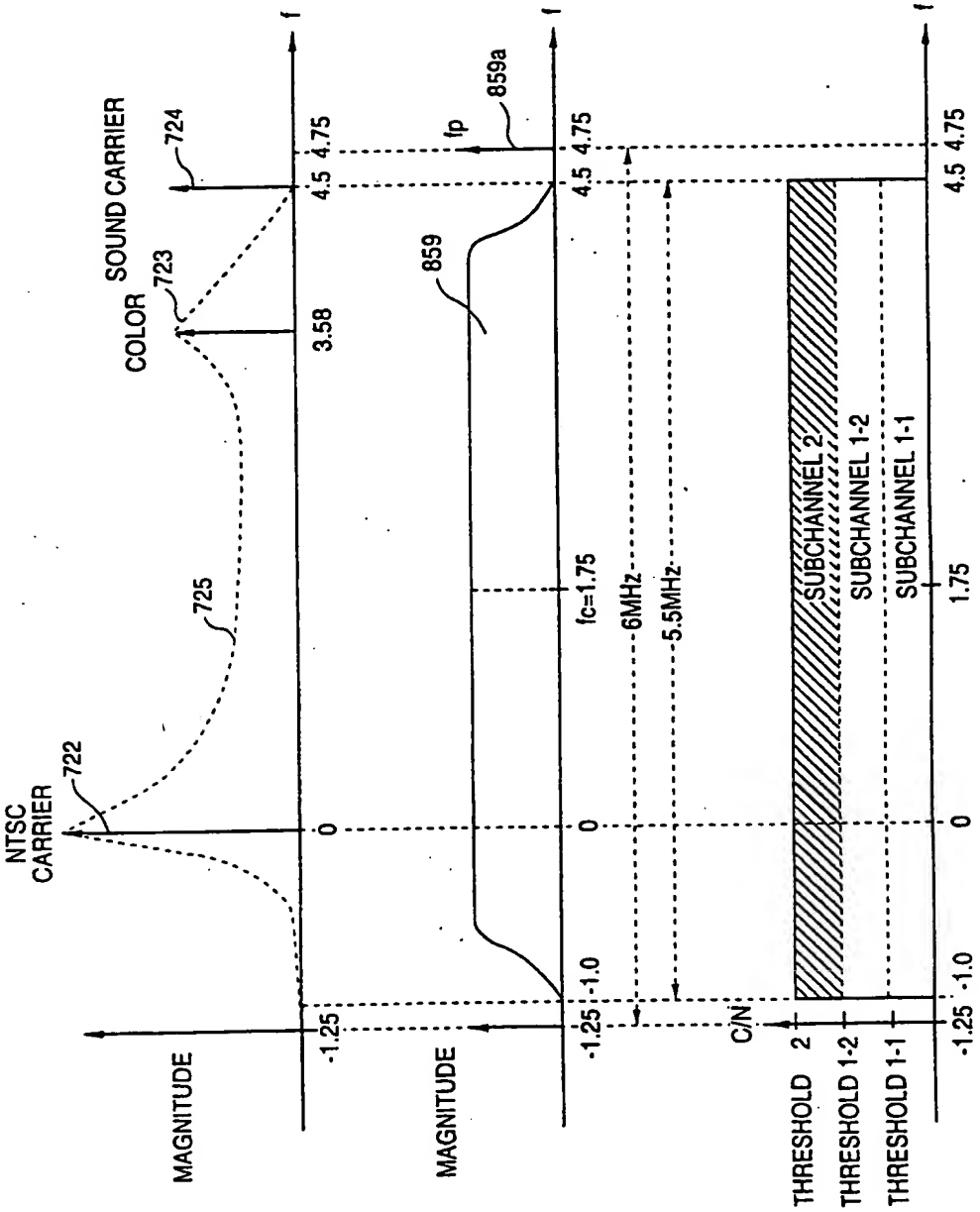

HDTV: 15.20Mbps
EDTV: 8Mbps
SDTV: 4Mbps
LDTV: 1.15Mbps
RECEIVER-3
RECEIVER-2
RECEIVER-1
36-SRQAM (S=1.8)
32-QAM
(16QAM)
(S=2.5)
-15.4%
+32.2%
+60.1%
(S=2.5)
(+10.8%)
(+34.2%)
HYBRID 36-SRQAM
REDUNDANCY
FOR FEC
SUBCHANNEL-2
SUBCHANNEL-1-2
SUBCHANNEL-1-1
(-29.0%)
EXTENDED
HDTV
EDTV(OR SDTV X 2)
SDTV
LDTV
100Mbps
50
30
20
10Mbps
5
3
2
1Mbps
0.5
TRANSFER RATE
(Mbps)
0
1000
2000
3000
4000
5000
COVERAGE AREA (SQUARE MILES)

FIG. 136


NTSC CARRIER
722
SOUND CARRIER
724
COLOR
723
725
MAGNITUDE
f
4.75
4.5
3.58
0
-1.25
859
859a
fp
fc=1.75
6MHz
5.5MHz
-1.0
C/N
SUBCHANNEL 2
SUBCHANNEL 1-2
SUBCHANNEL 1-1
1.75
THRESHOLD 2
THRESHOLD 1-2
THRESHOLD 1-1

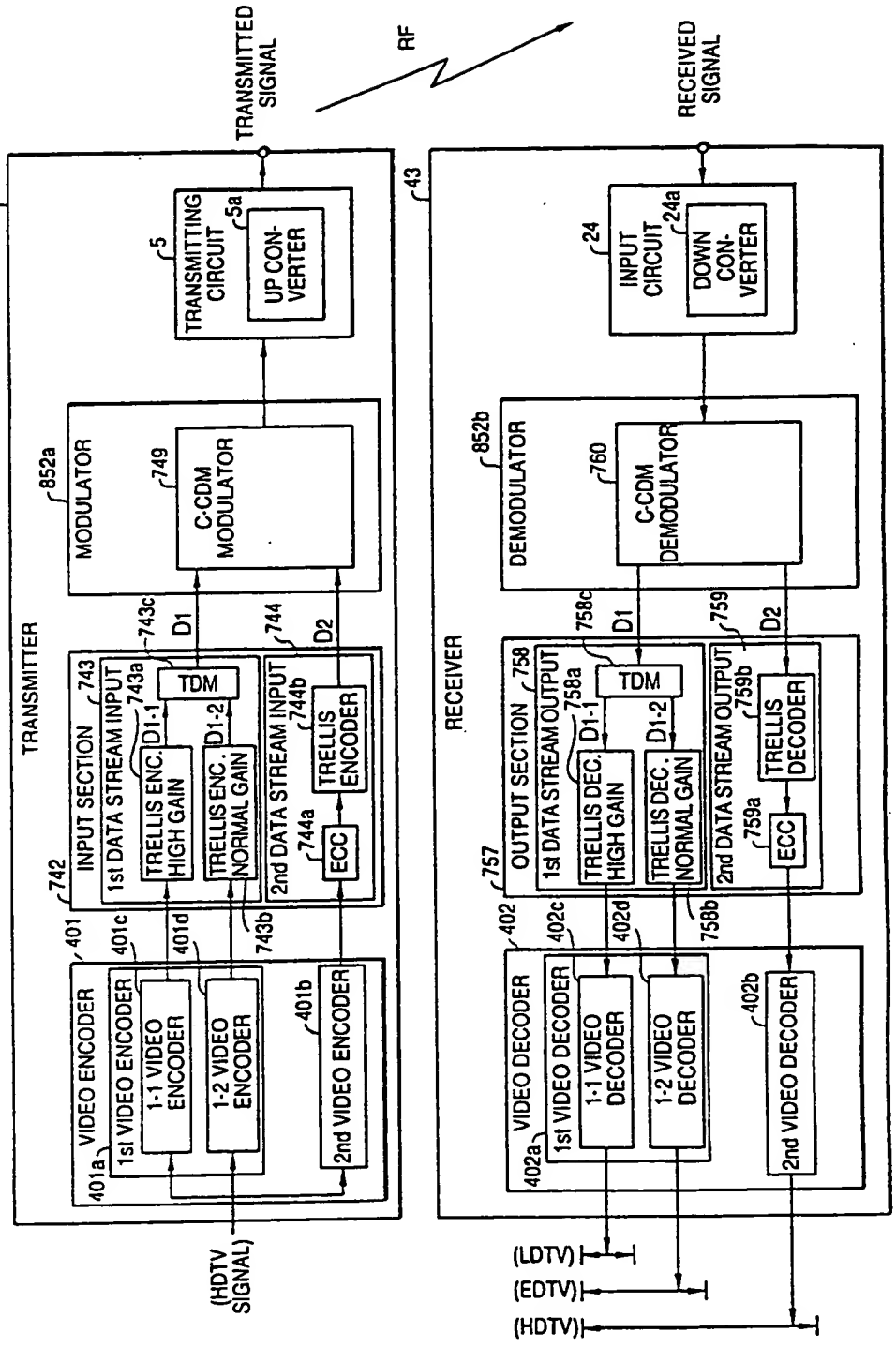

TRANSMITTED SIGNAL
RF
RECEIVED SIGNAL
TRANSMITTER
RECEIVER
TRANSMITTING CIRCUIT
UP CONVERTER
INPUT CIRCUIT
DOWN CONVERTER
MODULATOR
C-CDM MODULATOR
DEMODULATOR
C-CDM DEMODULATOR
INPUT SECTION
1st DATA STREAM INPUT
2nd DATA STREAM INPUT
TRELLIS ENC. HIGH GAIN
TRELLIS ENC. NORMAL GAIN
TRELLIS ENCODER
ECC
TDM
D1
D2
D1-1
D1-2
OUTPUT SECTION
1st DATA STREAM OUTPUT
2nd DATA STREAM OUTPUT
TRELLIS DEC. HIGH GAIN
TRELLIS DEC. NORMAL GAIN
TRELLIS DECODER
VIDEO ENCODER
1st VIDEO ENCODER
1-1 VIDEO ENCODER
1-2 VIDEO ENCODER
2nd VIDEO ENCODER
VIDEO DECODER
1st VIDEO DECODER
1-1 VIDEO DECODER
1-2 VIDEO DECODER
2nd VIDEO DECODER
(HDTV SIGNAL)
(LDTV)
(EDTV)
(HDTV)

FIG. 137

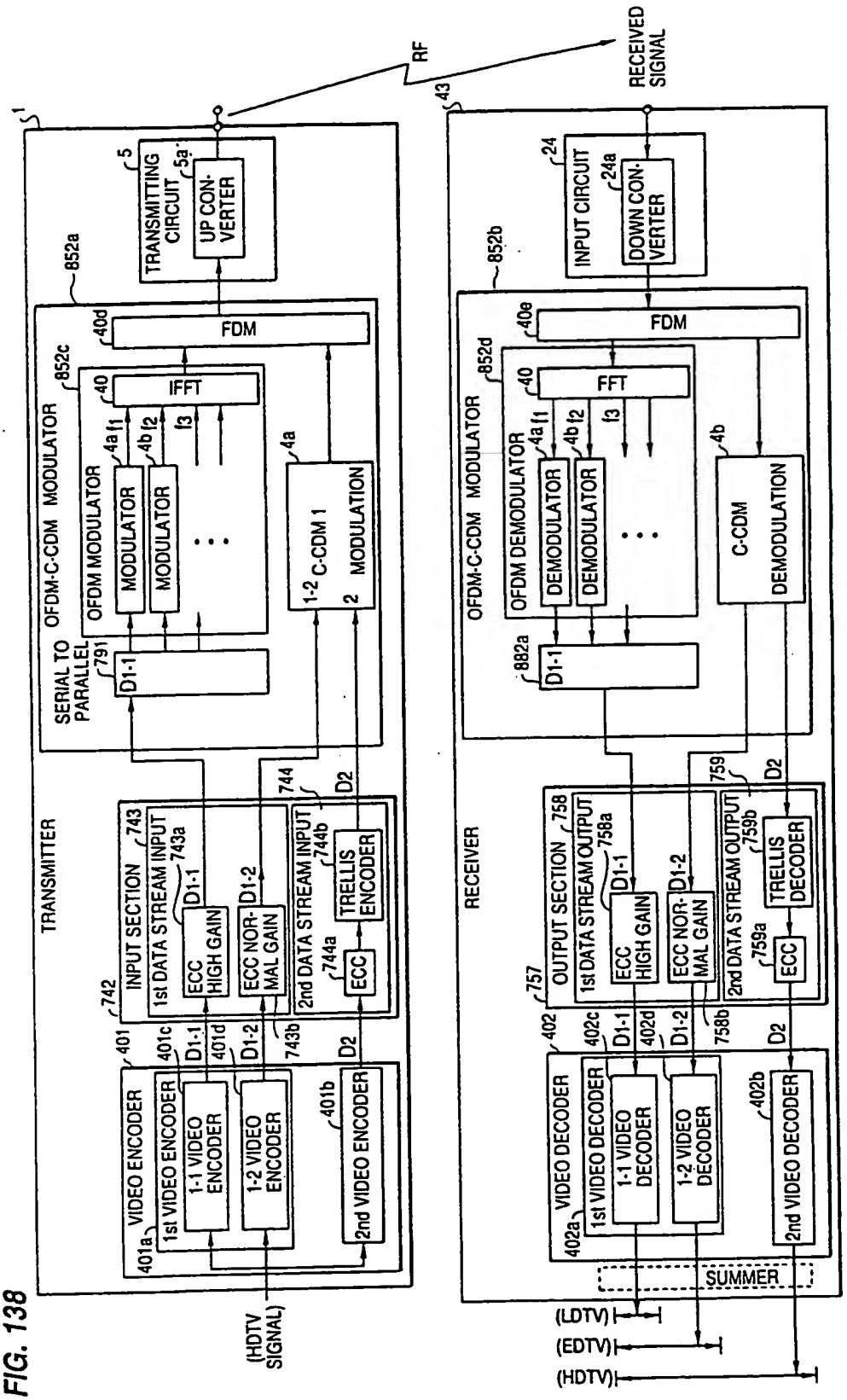

TRANSMITTER
RECEIVER
RF
RECEIVED SIGNAL
TRANSMITTING CIRCUIT
UP CONVERTER
INPUT CIRCUIT
DOWN CONVERTER
OFDM-C-CDM MODULATOR
SERIAL TO PARALLEL
OFDM MODULATOR
MODULATOR
IFFT
FDM
C-CDM MODULATION
INPUT SECTION
1st DATA STREAM INPUT
2nd DATA STREAM INPUT
ECC HIGH GAIN
ECC NORMAL GAIN
ECC
TRELLIS ENCODER
VIDEO ENCODER
1st VIDEO ENCODER
1-1 VIDEO ENCODER
1-2 VIDEO ENCODER
2nd VIDEO ENCODER
(HDTV SIGNAL)
OFDM-C-CDM MODULATOR
OFDM DEMODULATOR
DEMODULATOR
FFT
C-CDM DEMODULATION
OUTPUT SECTION
1st DATA STREAM OUTPUT
2nd DATA STREAM OUTPUT
TRELLIS DECODER
VIDEO DECODER
1st VIDEO DECODER
1-1 VIDEO DECODER
1-2 VIDEO DECODER
2nd VIDEO DECODER
SUMMER
(LDTV)
(EDTV)
(HDTV)

FIG. 138

FIG. 139

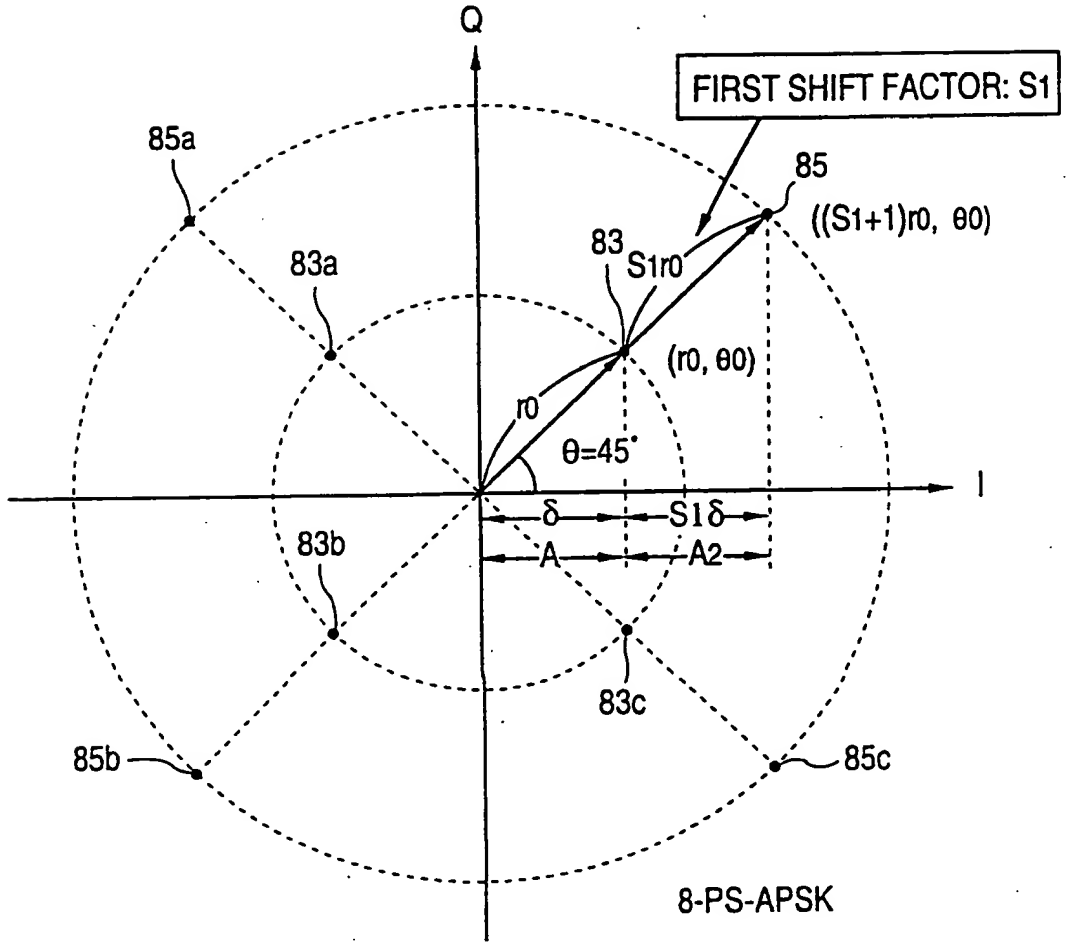

Q
I
FIRST SHIFT FACTOR: S1
85a
85
((S1+1)r0, θ0)
83
S1r0
83a
(r0, θ0)
r0
θ=45°
δ
S1δ
A
A2
83b
83c
85b
85c
8-PS-APSK

FIG. 140

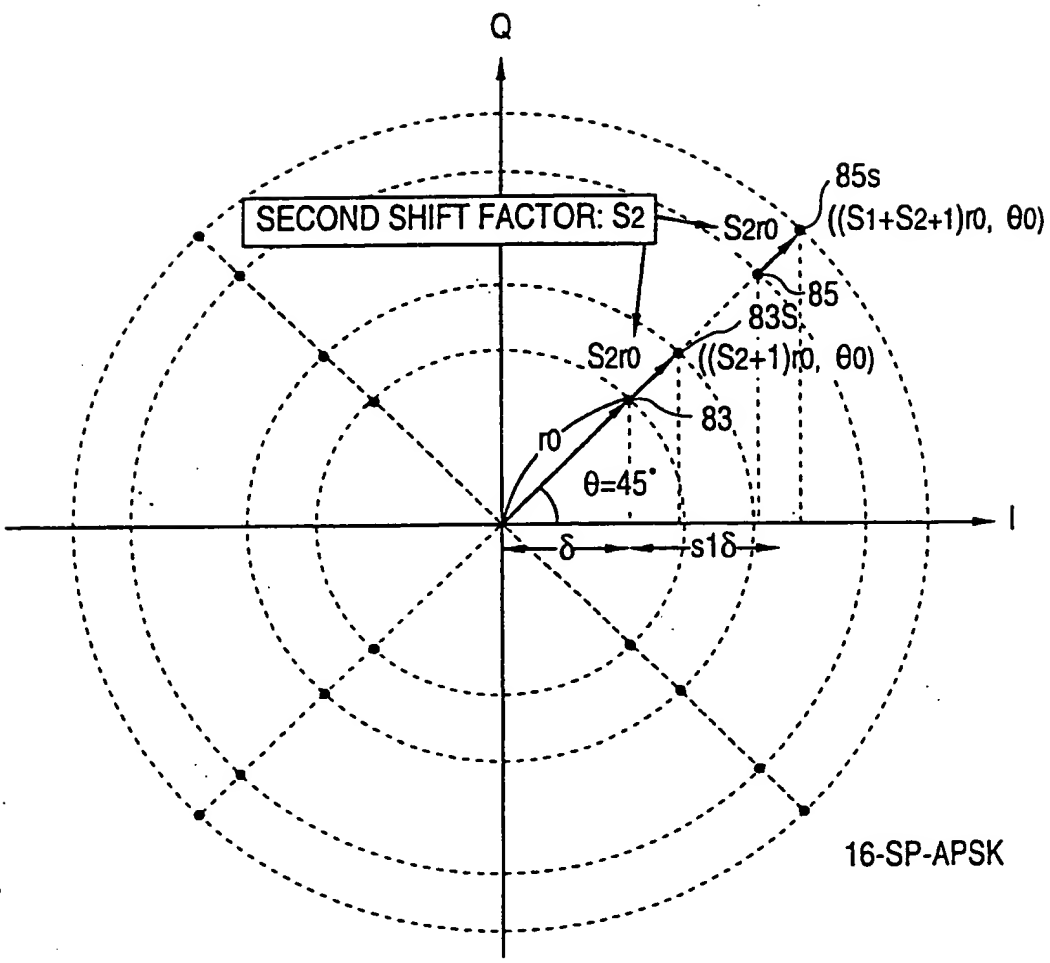

Q
I
SECOND SHIFT FACTOR: S2
S2r0
85s
((S1+S2+1)r0, θ0)
85
83S
S2r0
((S2+1)r0, θ0)
83
r0
θ=45°
δ
s1δ
16-SP-APSK

FIG. 141

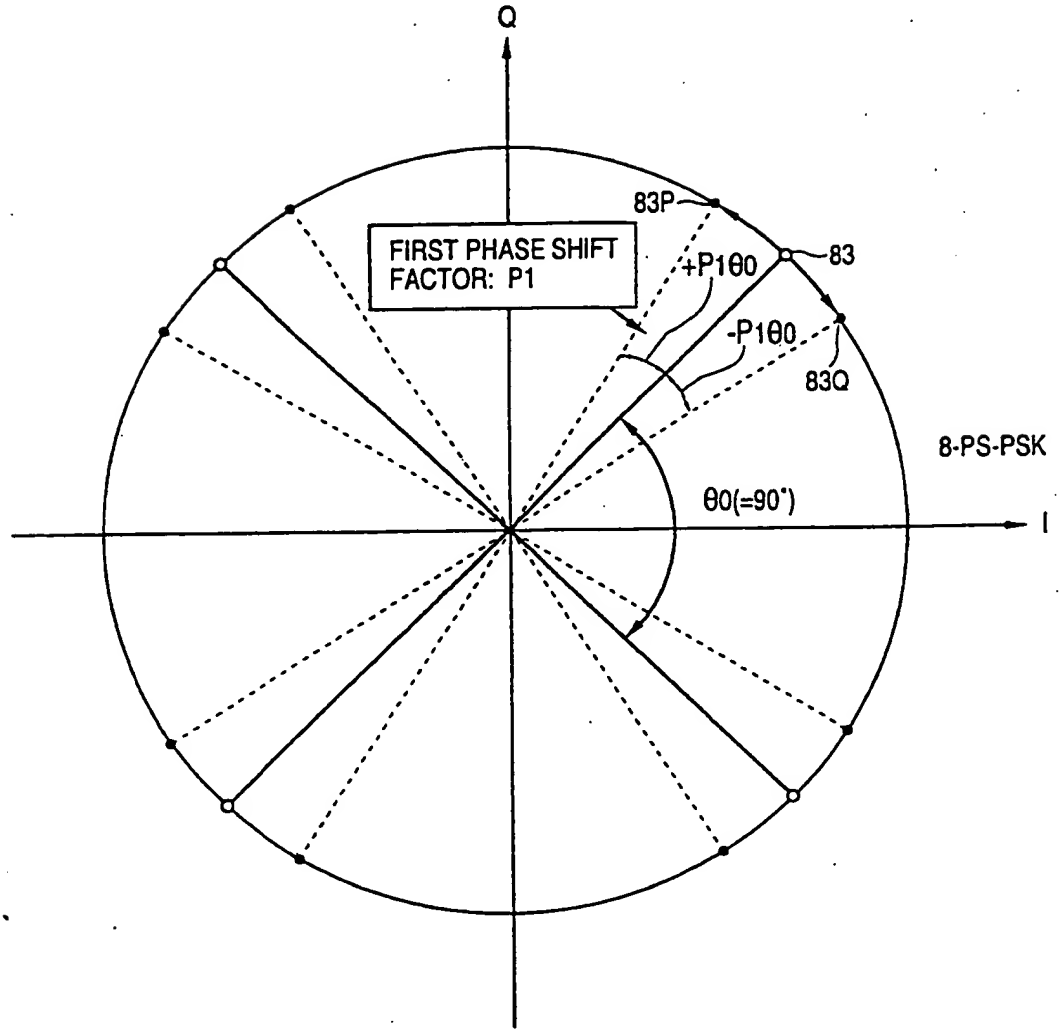

Q
I
83P
83
83Q
FIRST PHASE SHIFT FACTOR: P1
+P1θ0
-P1θ0
θ0(=90°)
8-PS-PSK

FIG. 142

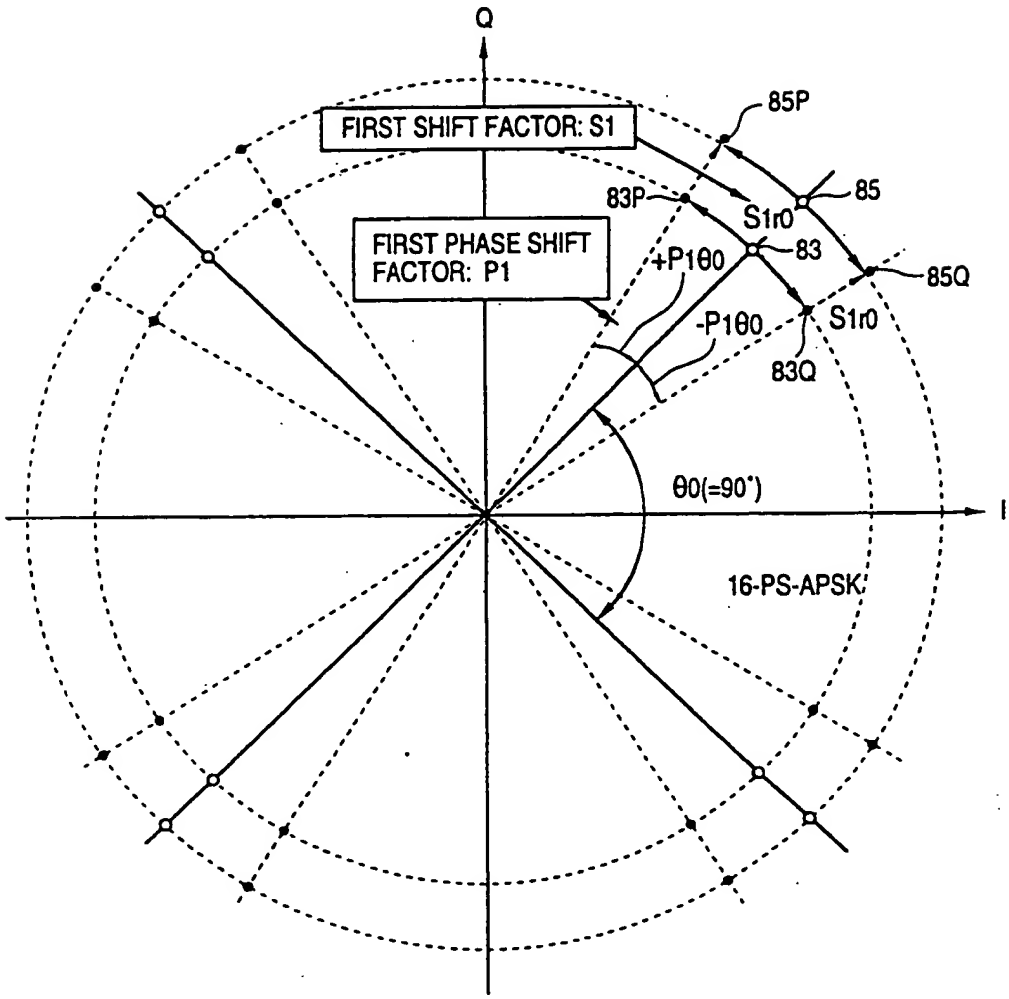
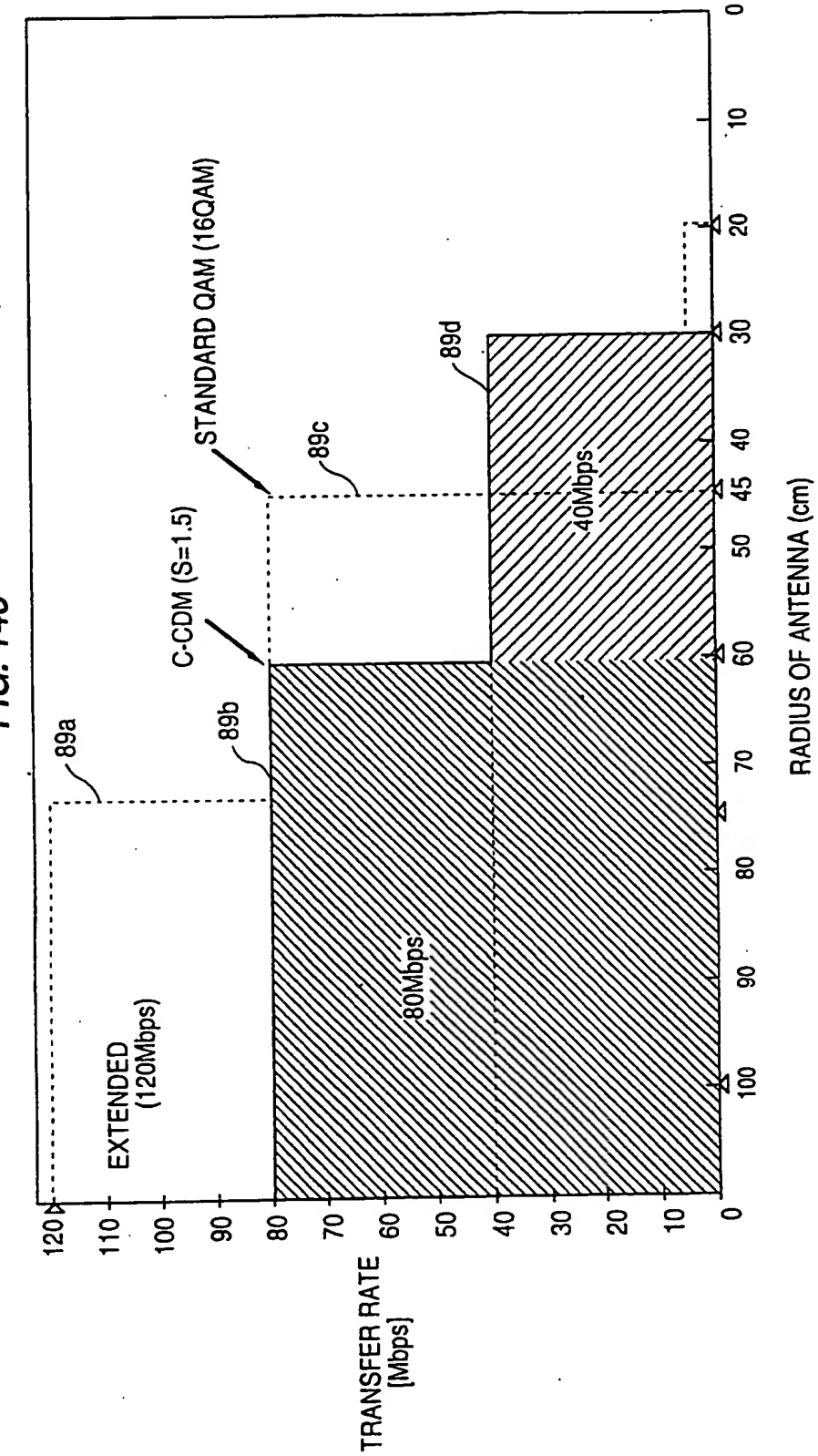

Q
I
FIRST SHIFT FACTOR: S1
FIRST PHASE SHIFT FACTOR: P1
85P
85
83P
S1r0
83
+P1θ0
85Q
-P1θ0
S1r0
83Q
θ0(=90°)
16-PS-APSK

FIG. 143


89a
89b
89c
89d
C-CDM (S=1.5)
STANDARD QAM (16QAM)
EXTENDED (120Mbps)
80Mbps
40Mbps
TRANSFER RATE [Mbps]
RADIUS OF ANTENNA (cm)
120
110
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
45
50
60
70
80
90
100

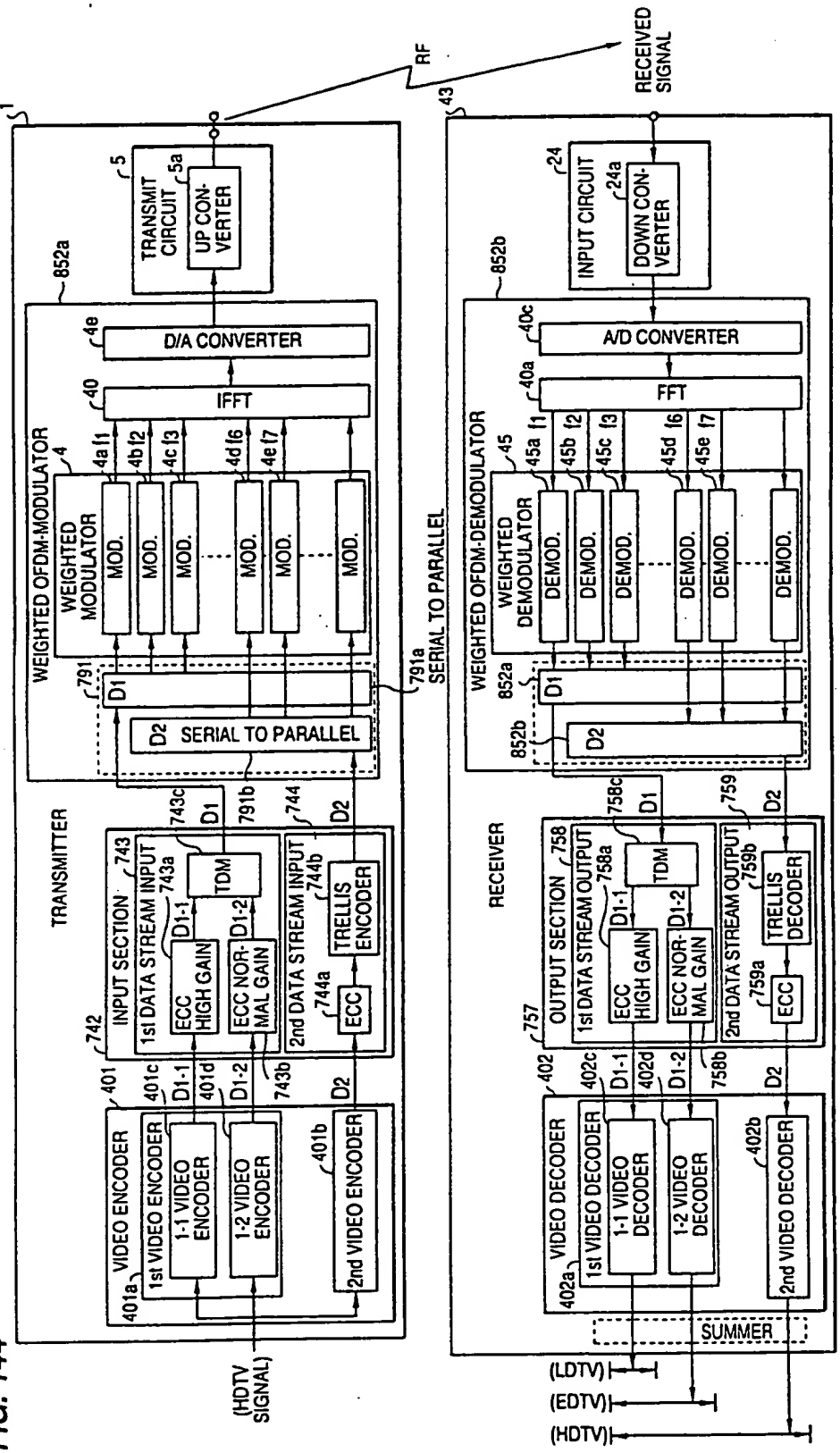

TRANSMITTER
RECEIVER
RF
RECEIVED SIGNAL
TRANSMIT CIRCUIT
UP CONVERTER
INPUT CIRCUIT
DOWN CONVERTER
D/A CONVERTER
A/D CONVERTER
IFFT
FFT
WEIGHTED OFDM-MODULATOR
WEIGHTED MODULATOR
MOD.
WEIGHTED OFDM-DEMODULATOR
WEIGHTED DEMODULATOR
DEMOD.
SERIAL TO PARALLEL
INPUT SECTION
1st DATA STREAM INPUT
2nd DATA STREAM INPUT
ECC HIGH GAIN
ECC NORMAL GAIN
TDM
TRELLIS ENCODER
ECC
OUTPUT SECTION
1st DATA STREAM OUTPUT
2nd DATA STREAM OUTPUT
TRELLIS DECODER
VIDEO ENCODER
1st VIDEO ENCODER
1-1 VIDEO ENCODER
1-2 VIDEO ENCODER
2nd VIDEO ENCODER
VIDEO DECODER
1st VIDEO DECODER
1-1 VIDEO DECODER
1-2 VIDEO DECODER
2nd VIDEO DECODER
SUMMER
(HDTV SIGNAL)
(LDTV)
(EDTV)
(HDTV)

FIG. 144

FIG. 145(a)

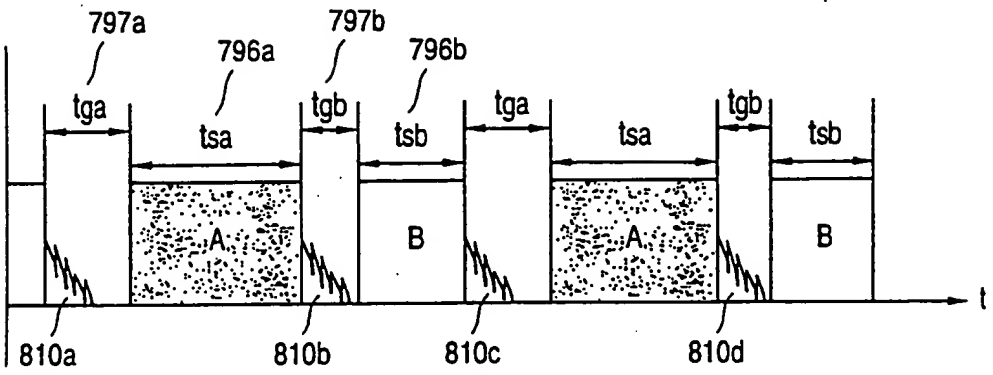
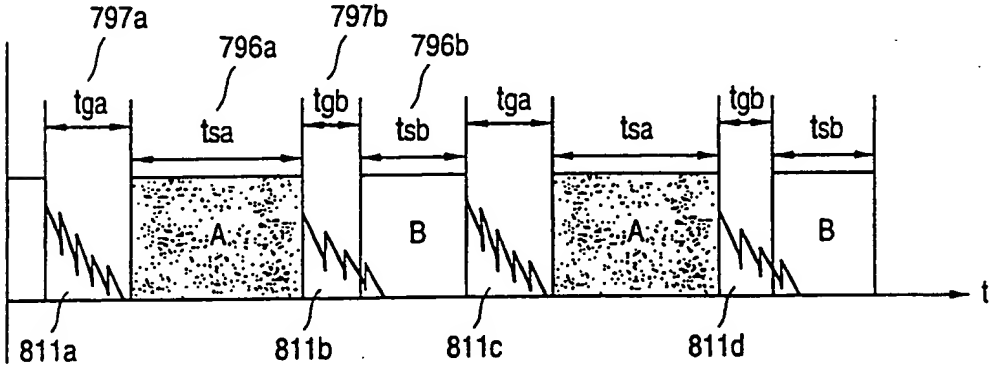


FIG. 145(b)



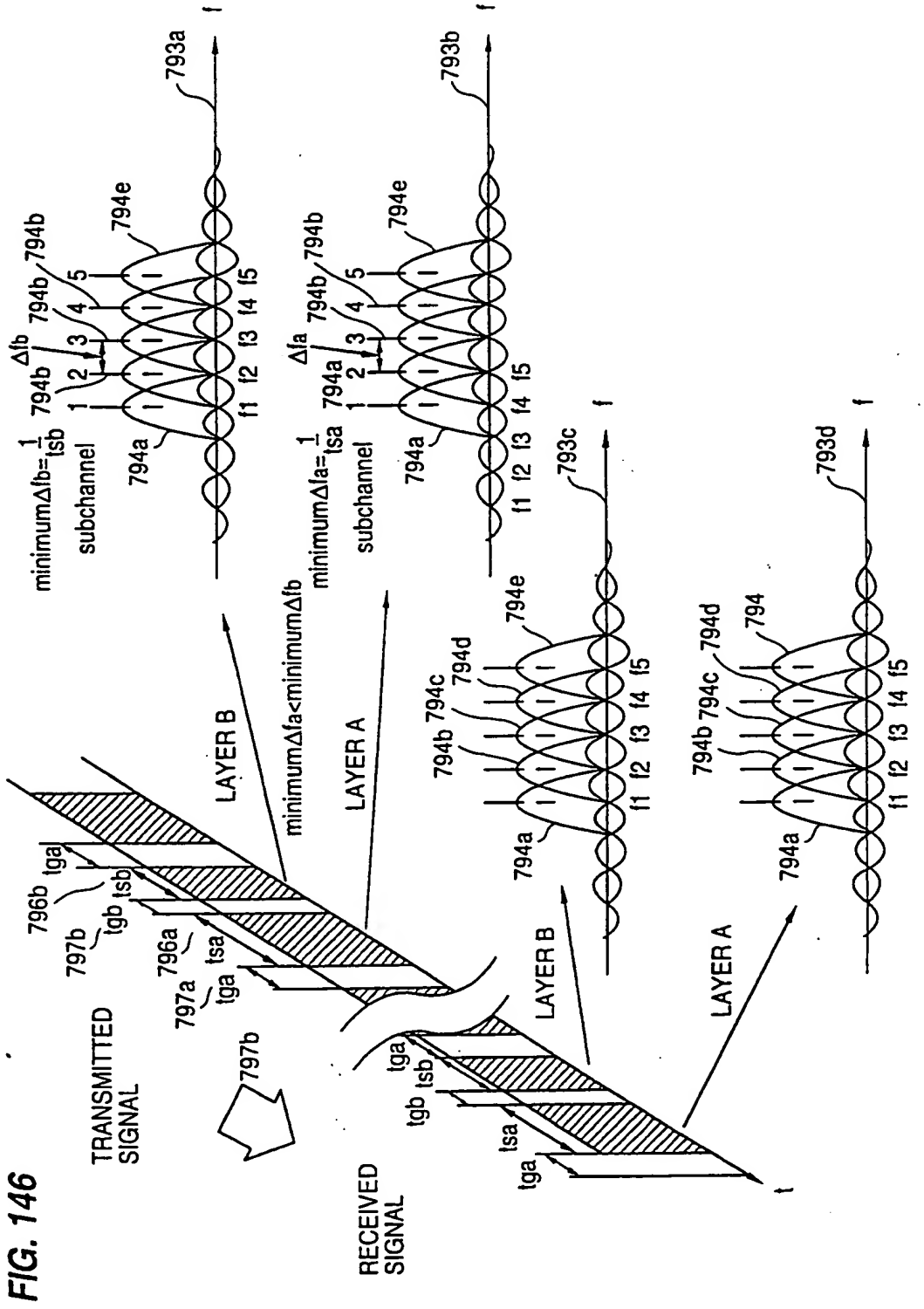

TRANSMITTED SIGNAL
RECEIVED SIGNAL
LAYER B
LAYER A
LAYER B
LAYER A
minimumΔfa<minimumΔfb
minimumΔfb=1/tsb
minimumΔfa=1/tsa
subchannel
subchannel
793a
793b
793c
793d
794
794a
794b
794c
794d
794e
796a
796b
797a
797b
tga
tgb
tsa
tsb
f1 f2 f3 f4 f5

FIG. 146

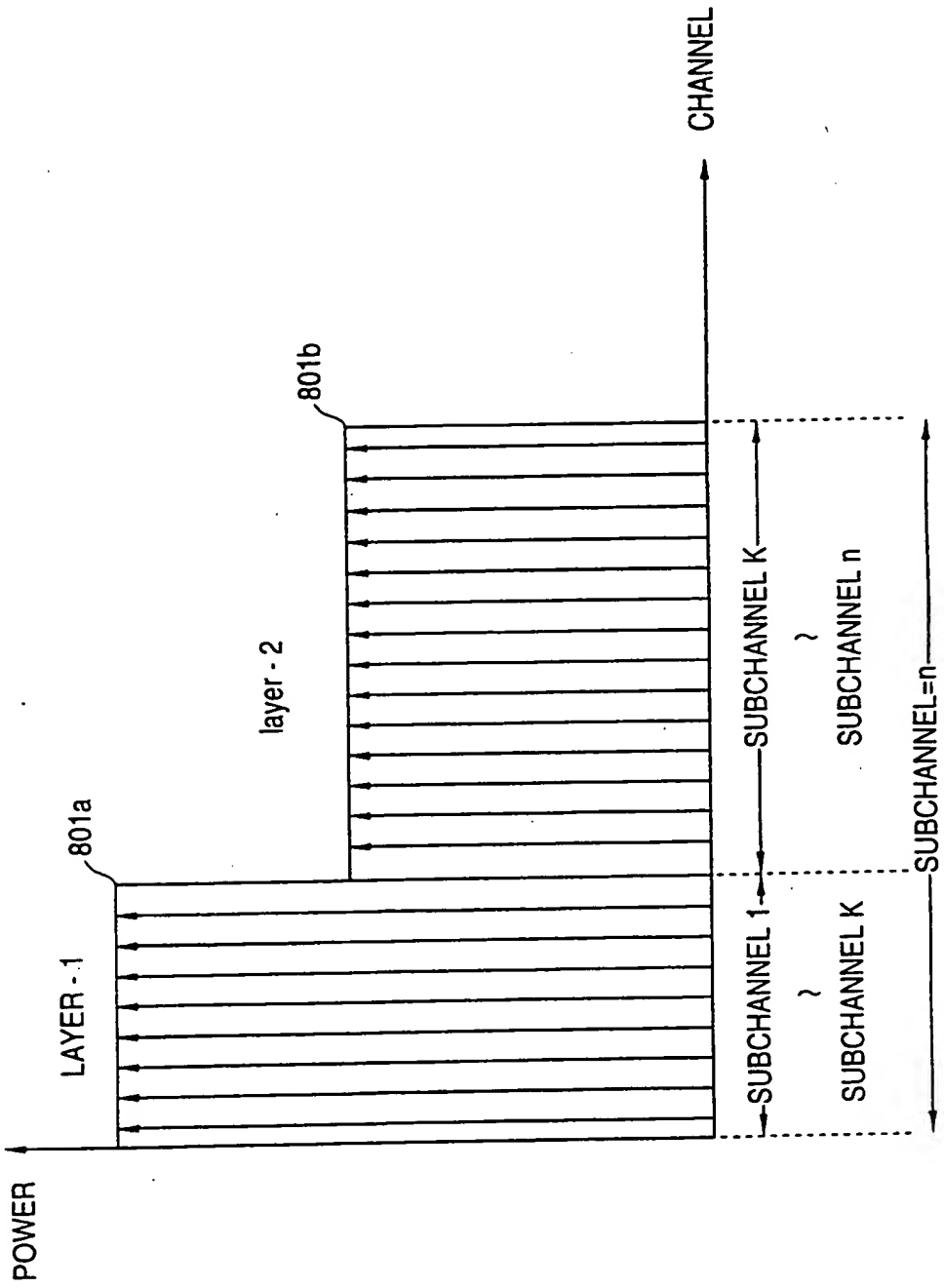
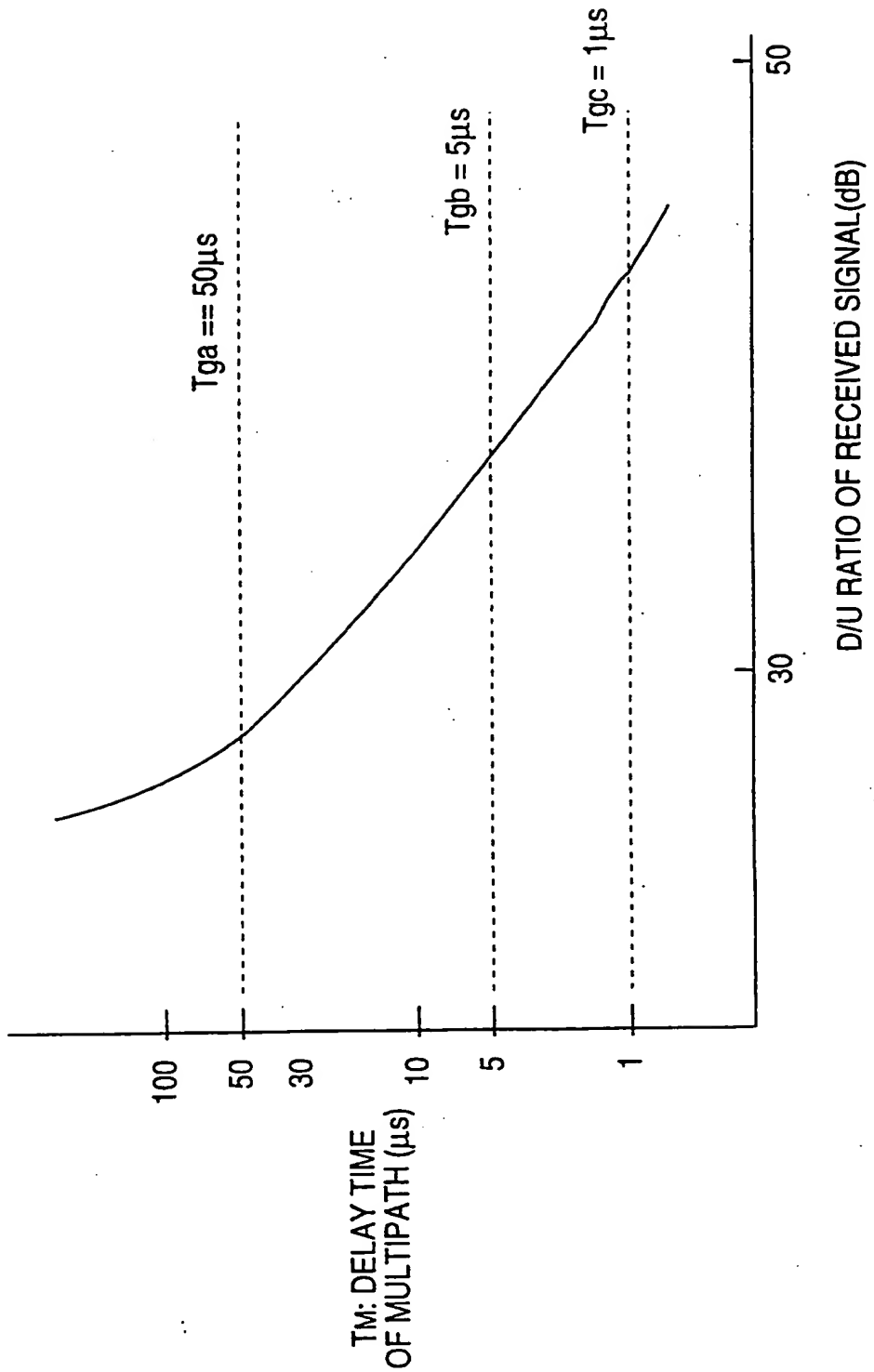

CHANNEL
801b
layer - 2
801a
LAYER - 1
SUBCHANNEL K
SUBCHANNEL n
SUBCHANNEL=n
SUBCHANNEL 1
SUBCHANNEL K
POWER

FIG. 147

FIG. 148


Tga == 50μs
Tgb = 5μs
Tgc = 1μs
100
50
30
10
5
1
TM: DELAY TIME OF MULTIPATH (μs)
50
30
D/U RATIO OF RECEIVED SIGNAL(dB)

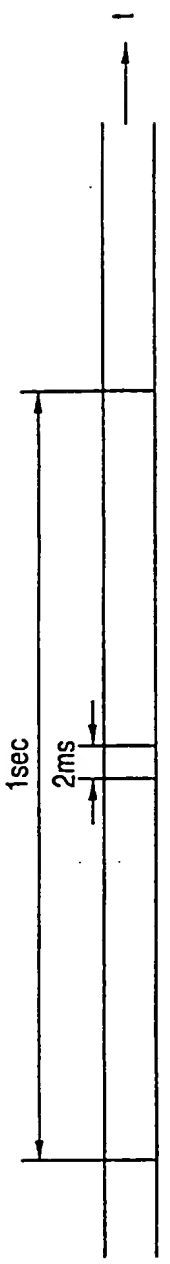


FIG. 149(a)

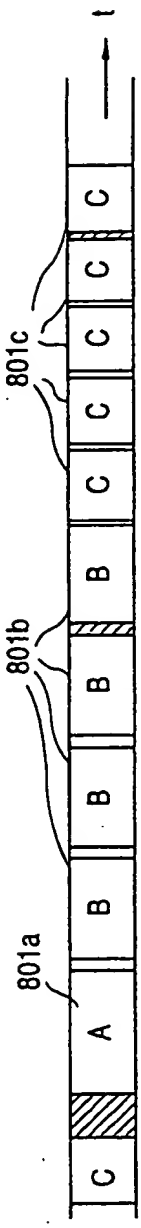


FIG. 149(b)

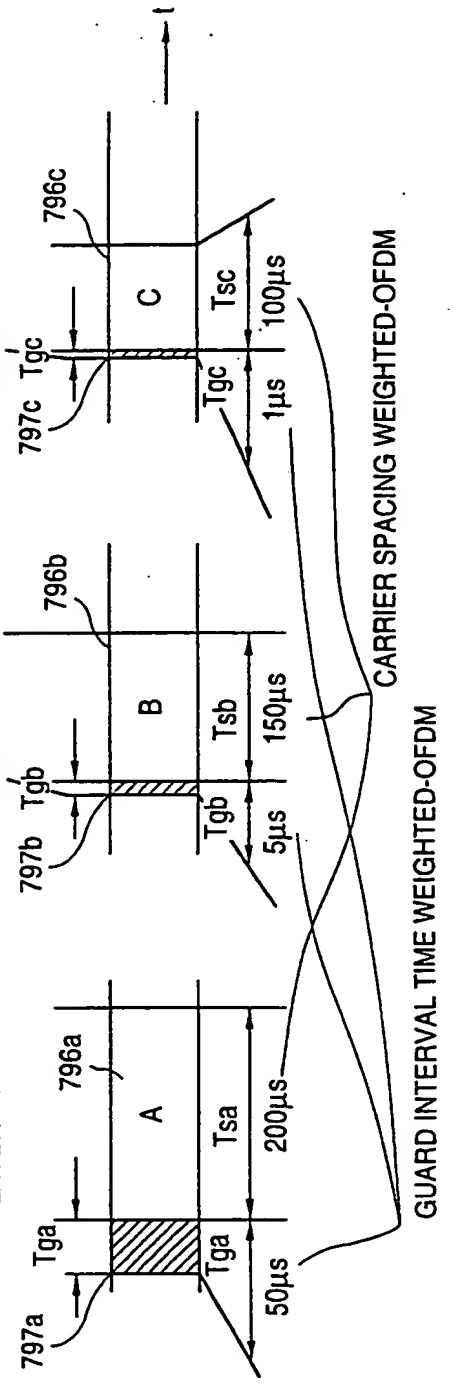


FIG. 149(c)

FIG. 150

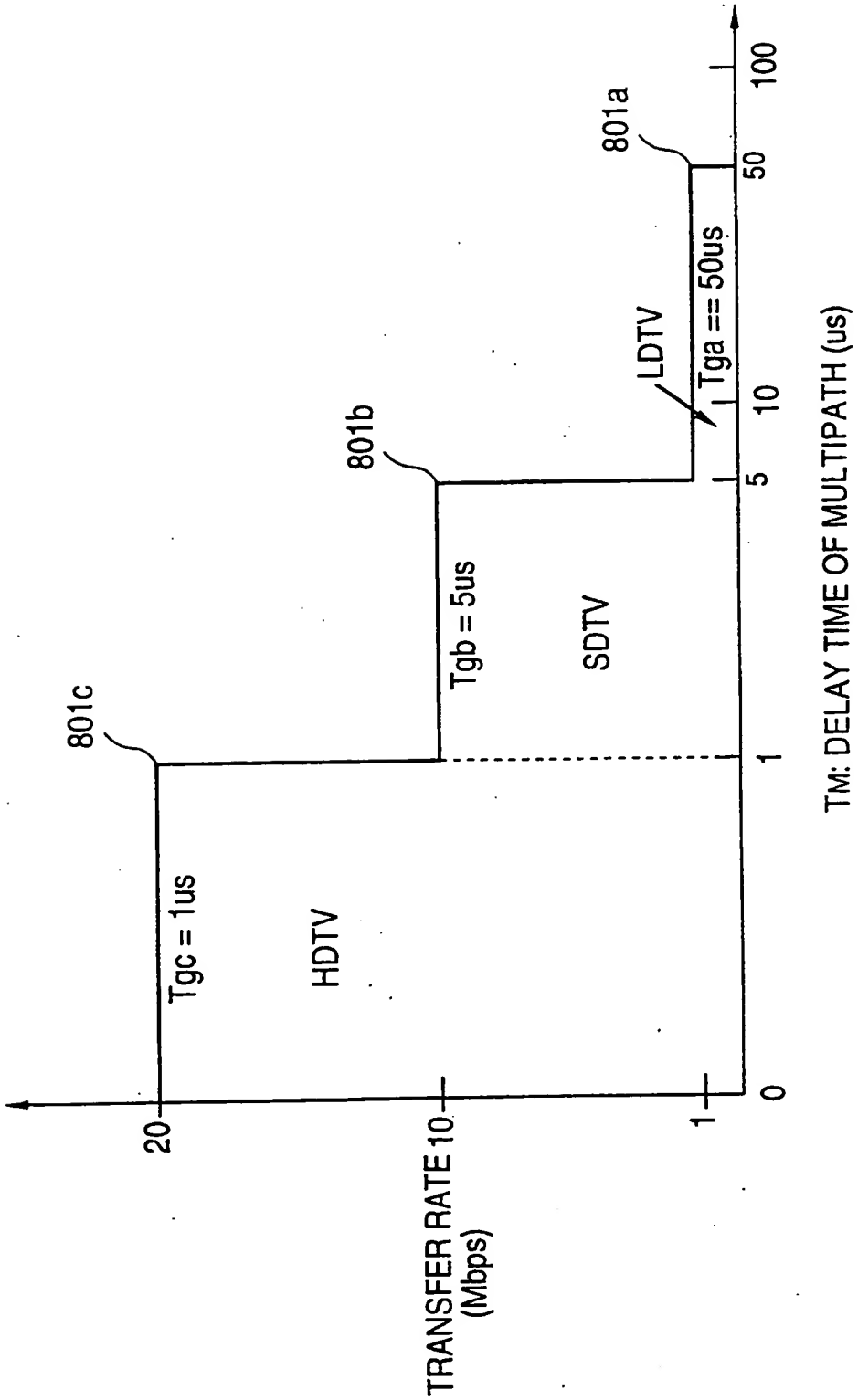

801a
801b
801c
LDTV
SDTV
HDTV
Tga == 50us
Tgb = 5us
Tgc = 1us
TRANSFER RATE (Mbps)
20
10
1
0
1
5
10
50
100
TM: DELAY TIME OF MULTIPATH (us)

FIG. 151

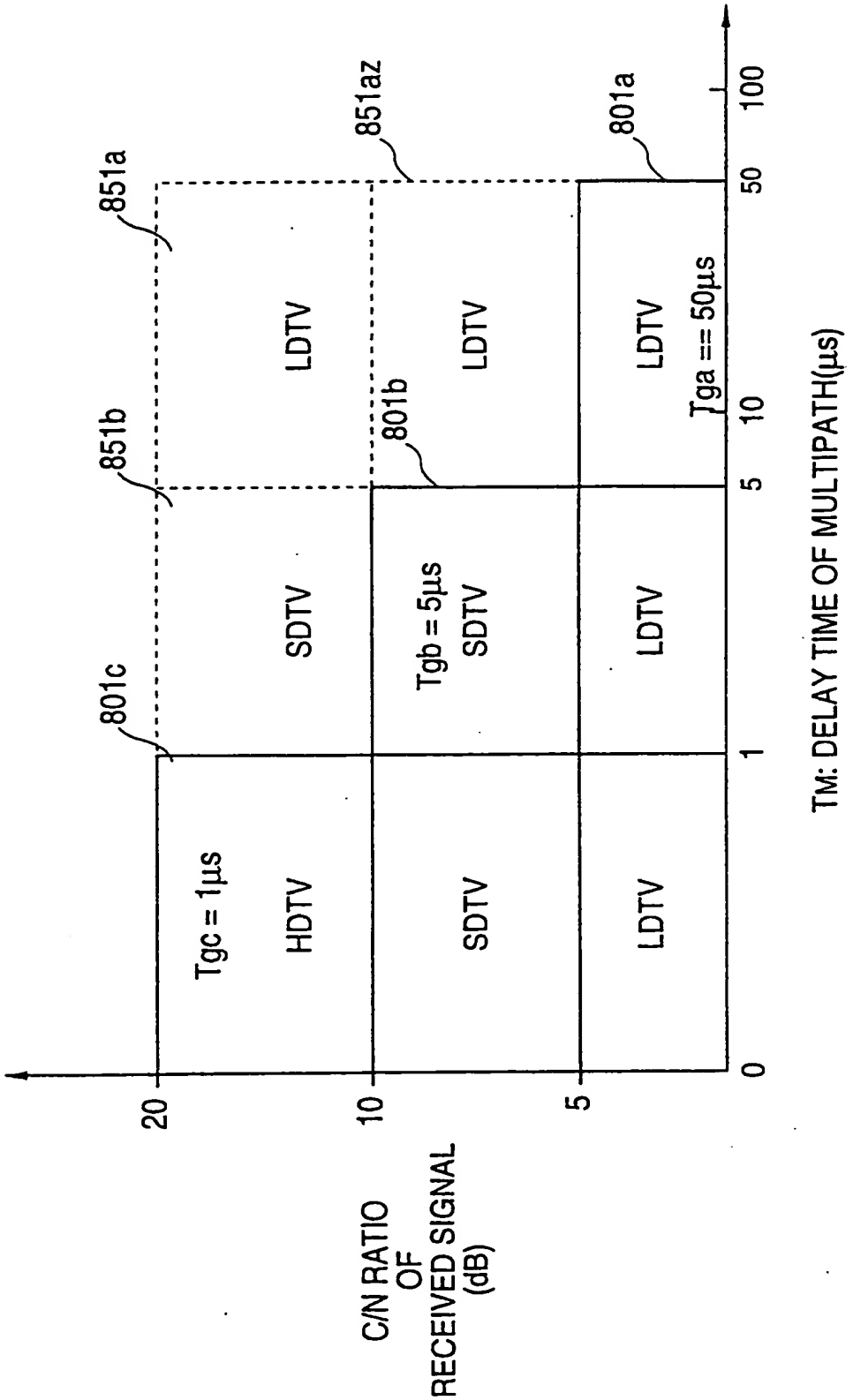
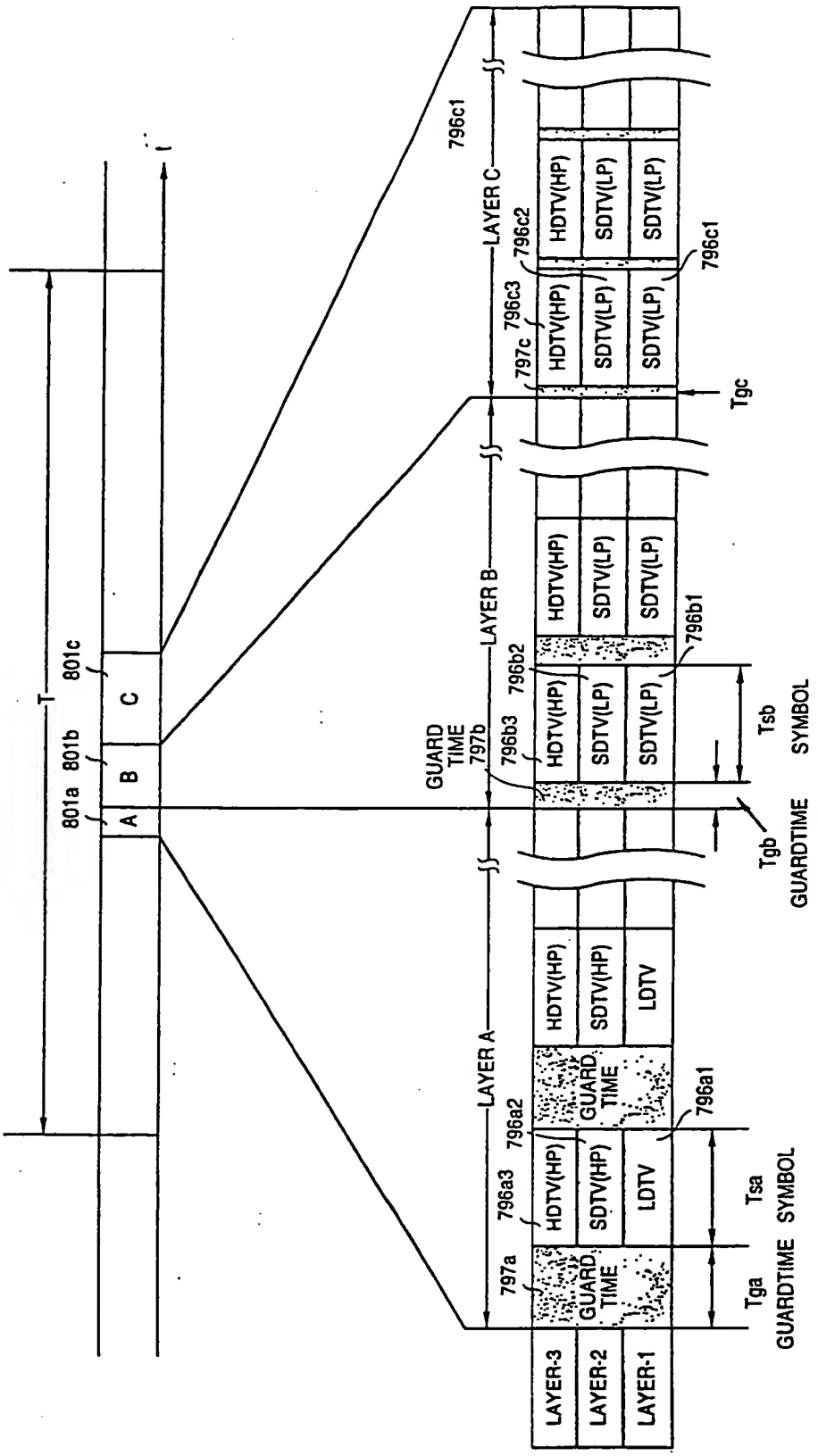

851a
851az
801a
851b
801b
801c
LDTV
LDTV
LDTV
SDTV
SDTV
LDTV
HDTV
SDTV
LDTV
Tga == 50μs
Tgb = 5μs
Tgc = 1μs
20
10
5
0
1
5
10
50
100
C/N RATIO OF RECEIVED SIGNAL (dB)
TM: DELAY TIME OF MULTIPATH(μs)

FIG. 152


T
801a
801b
801c
A
B
C
LAYER A
LAYER B
LAYER C
796c1
796c2
796c3
797c
796b1
796b2
796b3
797b
796a1
796a2
796a3
797a
GUARD TIME
HDTV(HP)
SDTV(HP)
LDTV
SDTV(LP)
Tgc
Tgb
Tga
Tsb
Tsa
GUARDTIME
SYMBOL
LAYER-3
LAYER-2
LAYER-1

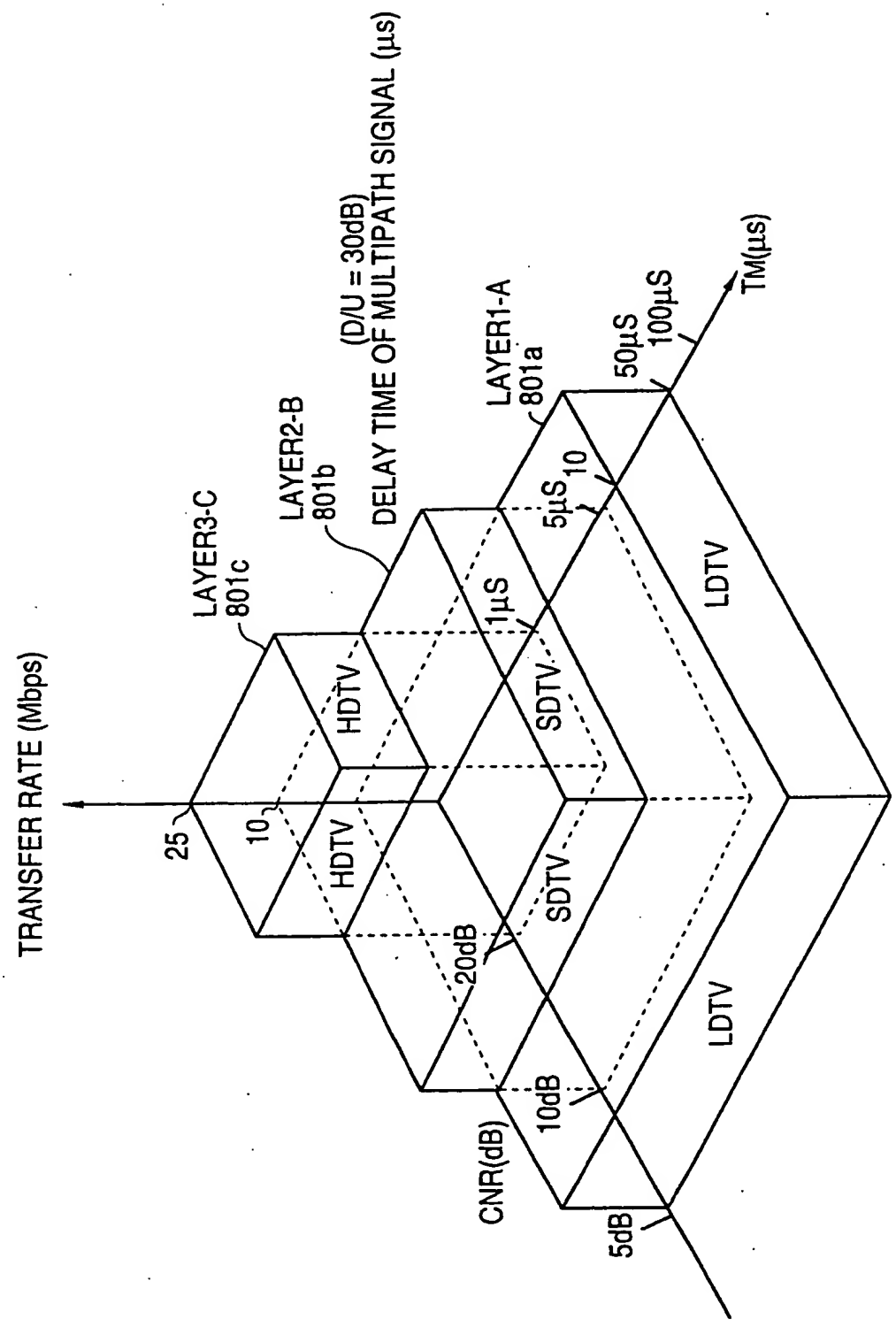

TRANSFER RATE (Mbps)
25
10
LAYER3-C
801c
LAYER2-B
801b
LAYER1-A
801a
(D/U = 30dB)
DELAY TIME OF MULTIPATH SIGNAL (μs)
HDTV
HDTV
SDTV
SDTV
LDTV
LDTV
1μS
5μS
10
20dB
10dB
5dB
50μS
100μS
TM(μs)
CNR(dB)

FIG. 153

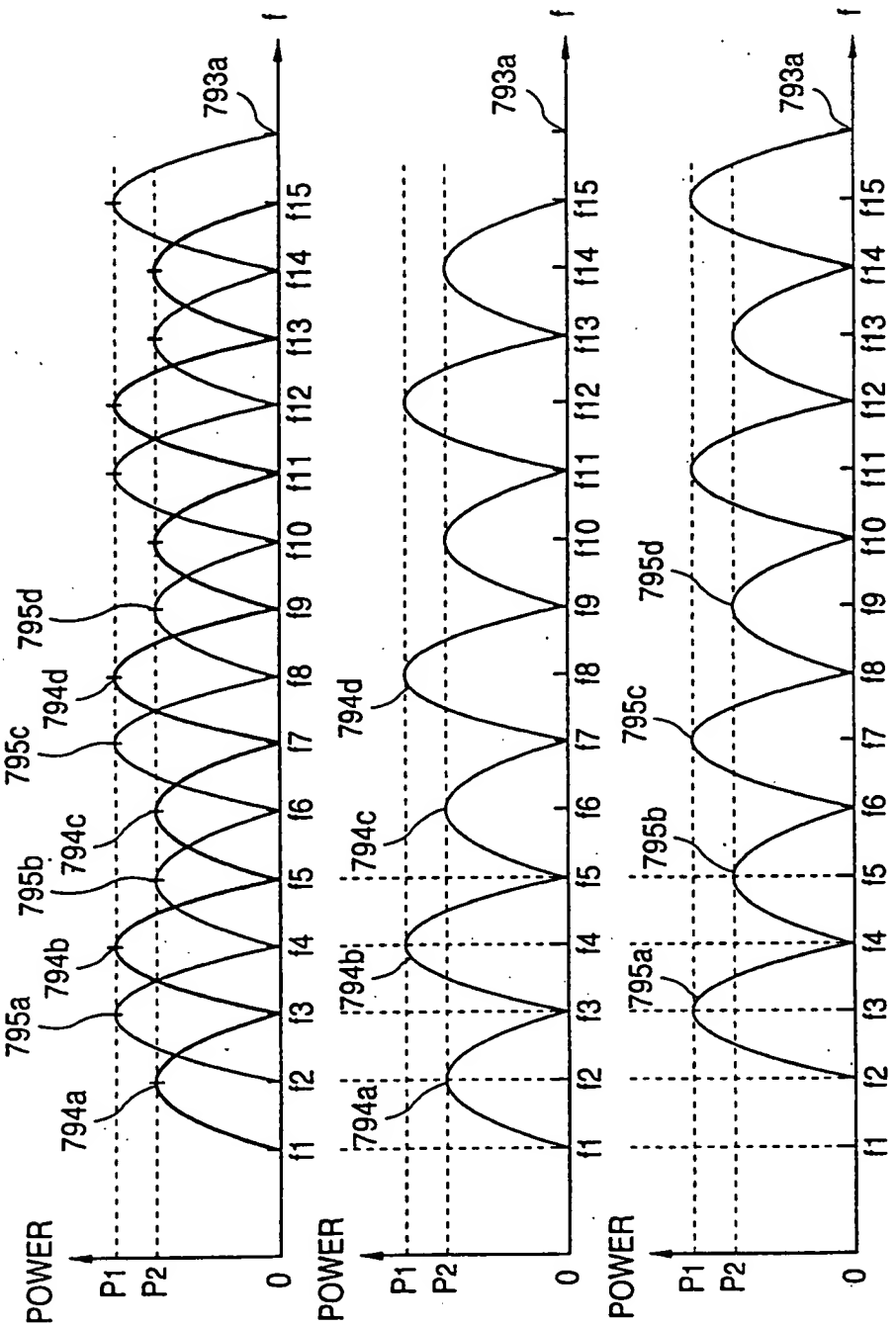


FIG. 154(a)

FIG. 154(b)

FIG. 154(c)

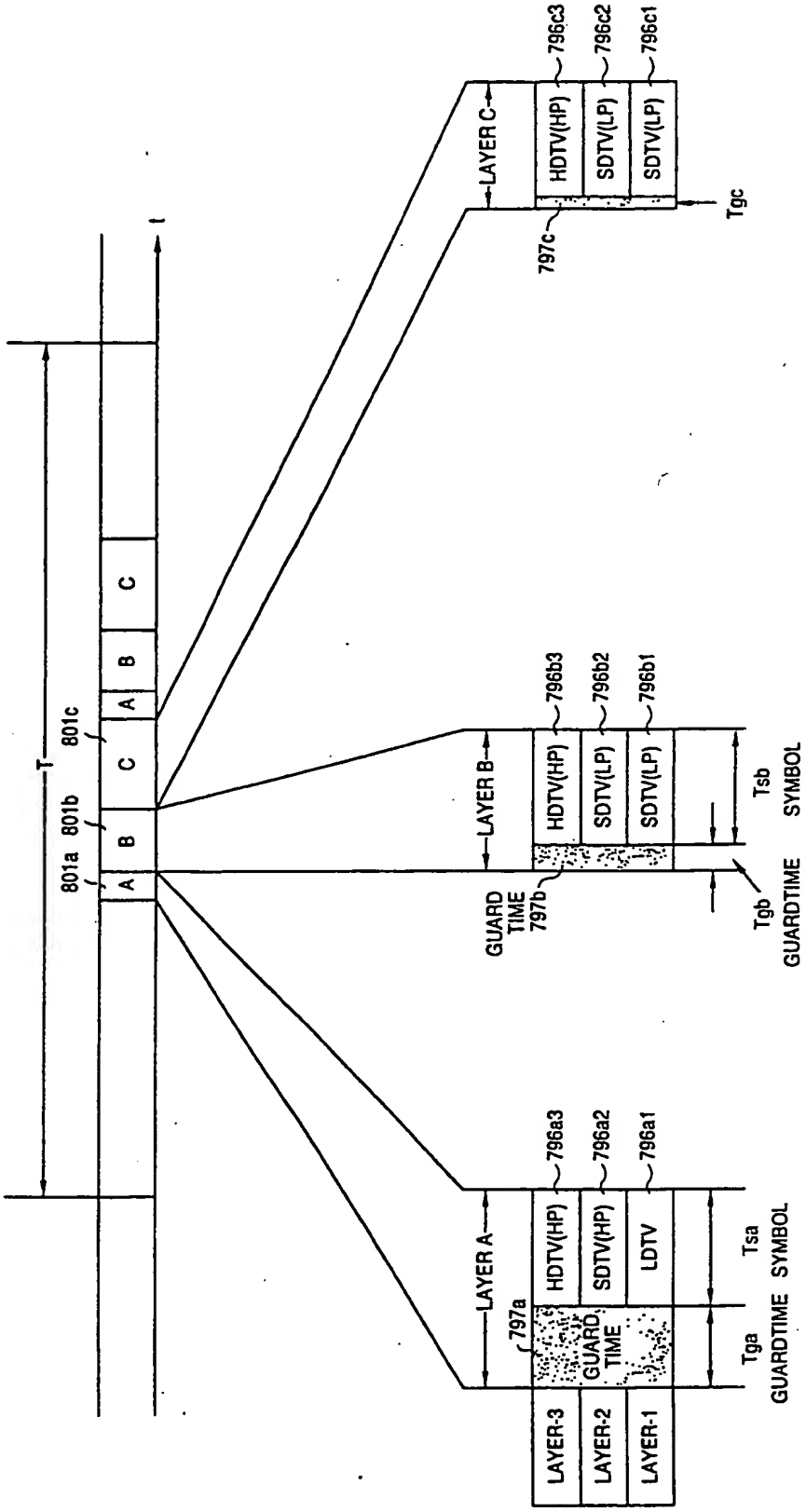

t
T
801a
801b
801c
A
B
C
A
B
C
LAYER A
LAYER B
LAYER C
796a3
796a2
796a1
796b3
796b2
796b1
796c3
796c2
796c1
HDTV(HP)
SDTV(HP)
LDTV
HDTV(HP)
SDTV(LP)
SDTV(LP)
HDTV(HP)
SDTV(LP)
SDTV(LP)
797a
GUARD TIME
797b
GUARD TIME
797c
Tga
GUARDTIME
Tsa
SYMBOL
Tgb
GUARDTIME
Tsb
SYMBOL
Tgc
LAYER-3
LAYER-2
LAYER-1

FIG. 155

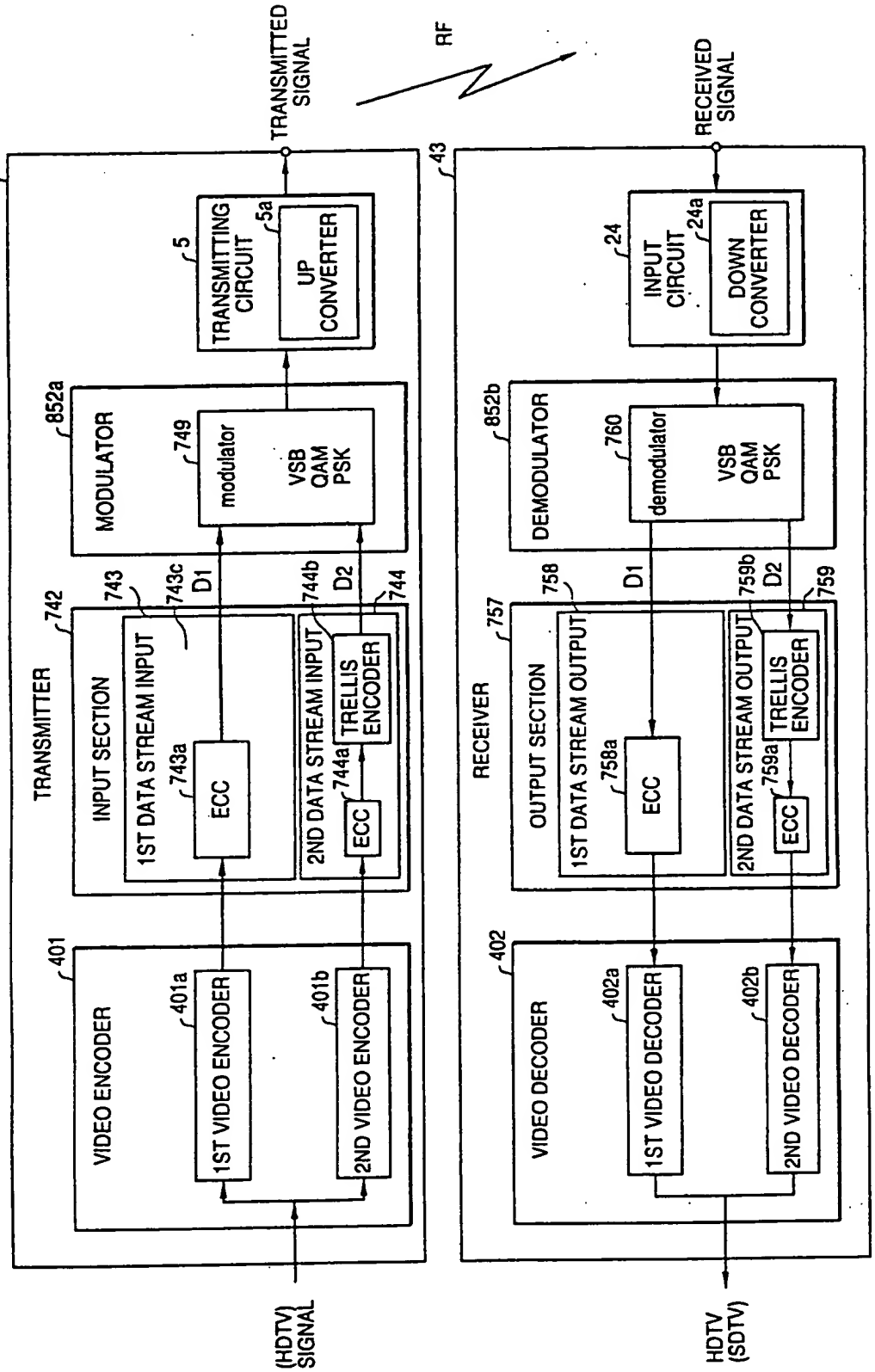

TRANSMITTED SIGNAL
RF
RECEIVED SIGNAL
1
43
TRANSMITTER
RECEIVER
5
TRANSMITTING CIRCUIT
5a
UP CONVERTER
24
INPUT CIRCUIT
24a
DOWN CONVERTER
852a
MODULATOR
749
modulator
VSB QAM PSK
852b
DEMODULATOR
760
demodulator
VSB QAM PSK
742
INPUT SECTION
743
1ST DATA STREAM INPUT
743a
ECC
743c
D1
744
2ND DATA STREAM INPUT
744a
ECC
TRELLIS ENCODER
744b
D2
757
OUTPUT SECTION
758
1ST DATA STREAM OUTPUT
758a
ECC
D1
759
2ND DATA STREAM OUTPUT
759a
ECC
TRELLIS ENCODER
759b
D2
401
VIDEO ENCODER
401a
1ST VIDEO ENCODER
401b
2ND VIDEO ENCODER
402
VIDEO DECODER
402a
1ST VIDEO DECODER
402b
2ND VIDEO DECODER
(HDTV) SIGNAL
HDTV (SDTV)

FIG. 156

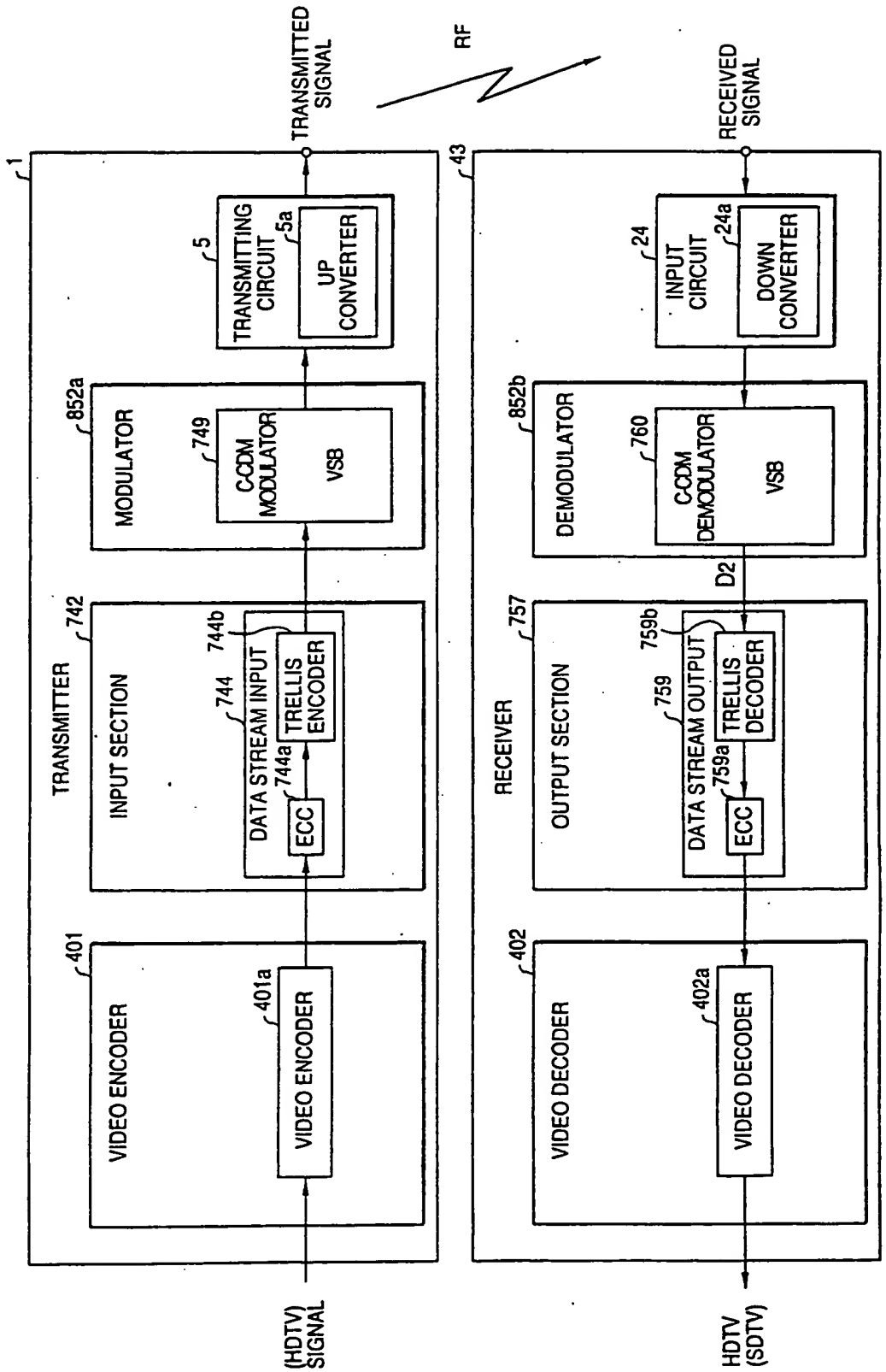
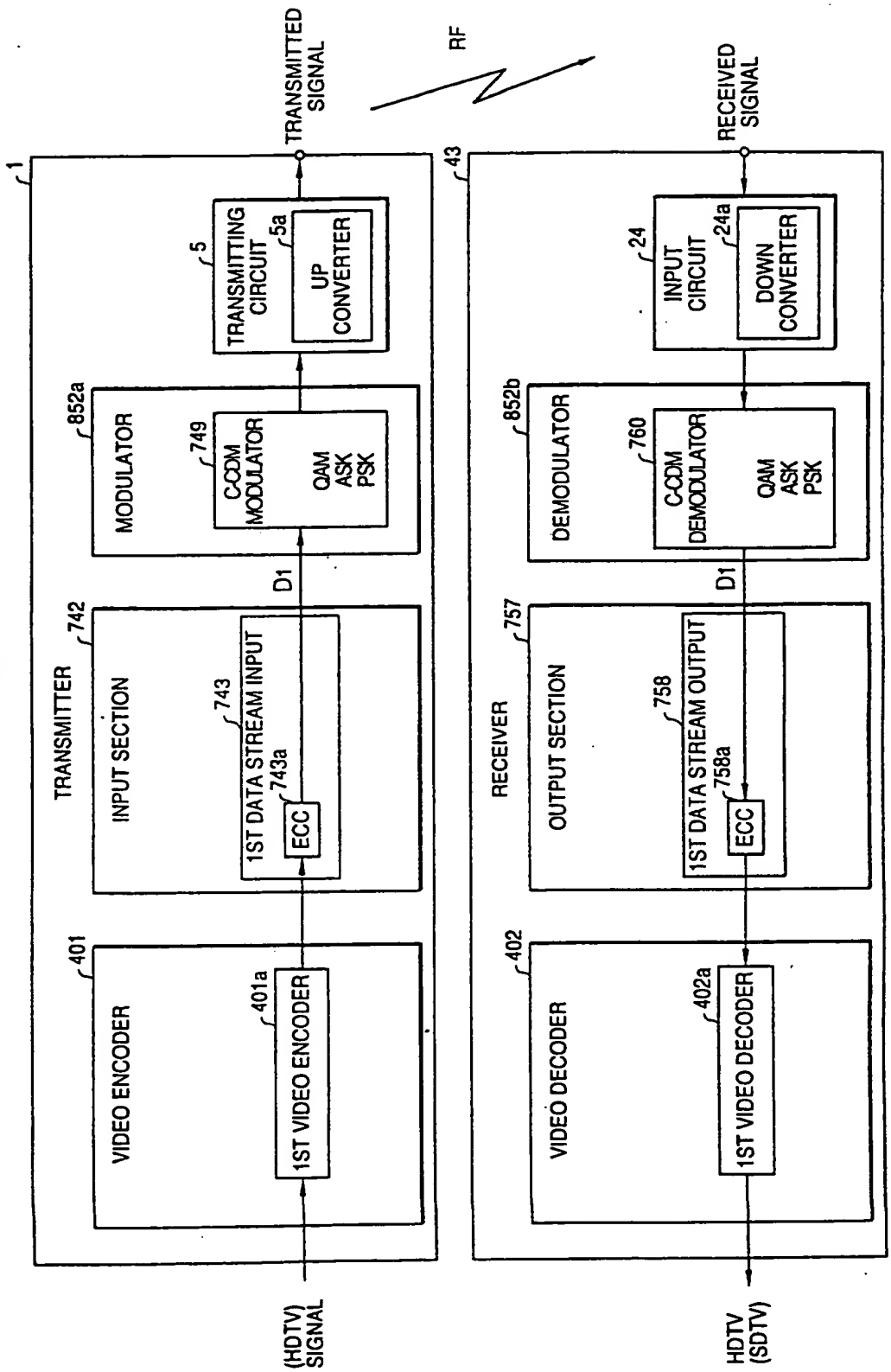

TRANSMITTED SIGNAL
RF
RECEIVED SIGNAL
1
43
TRANSMITTER
RECEIVER
401
VIDEO ENCODER
401a
VIDEO ENCODER
742
INPUT SECTION
744
DATA STREAM INPUT
744a
ECC
744b
TRELLIS ENCODER
852a
MODULATOR
749
COFDM MODULATOR
VSB
5
TRANSMITTING CIRCUIT
5a
UP CONVERTER
(HDTV) SIGNAL
402
VIDEO DECODER
402a
VIDEO DECODER
757
OUTPUT SECTION
759
DATA STREAM OUTPUT
759a
ECC
759b
TRELLIS DECODER
852b
DEMODULATOR
760
COFDM DEMODULATOR
VSB
D2
24
INPUT CIRCUIT
24a
DOWN CONVERTER
HDTV (SDTV)

FIG. 157

FIG. 158


TRANSMITTED SIGNAL
RF
RECEIVED SIGNAL
1
43
TRANSMITTING CIRCUIT
5
5a
UP CONVERTER
INPUT CIRCUIT
24
24a
DOWN CONVERTER
MODULATOR
852a
749
C-CDM MODULATOR
QAM ASK PSK
DEMODULATOR
852b
760
C-CDM DEMODULATOR
QAM ASK PSK
TRANSMITTER
INPUT SECTION
742
743
1ST DATA STREAM INPUT
743a
ECC
D1
RECEIVER
OUTPUT SECTION
757
758
1ST DATA STREAM OUTPUT
758a
ECC
D1
VIDEO ENCODER
401
401a
1ST VIDEO ENCODER
VIDEO DECODER
402
402a
1ST VIDEO DECODER
(HDTV) SIGNAL
HDTV (SDTV)

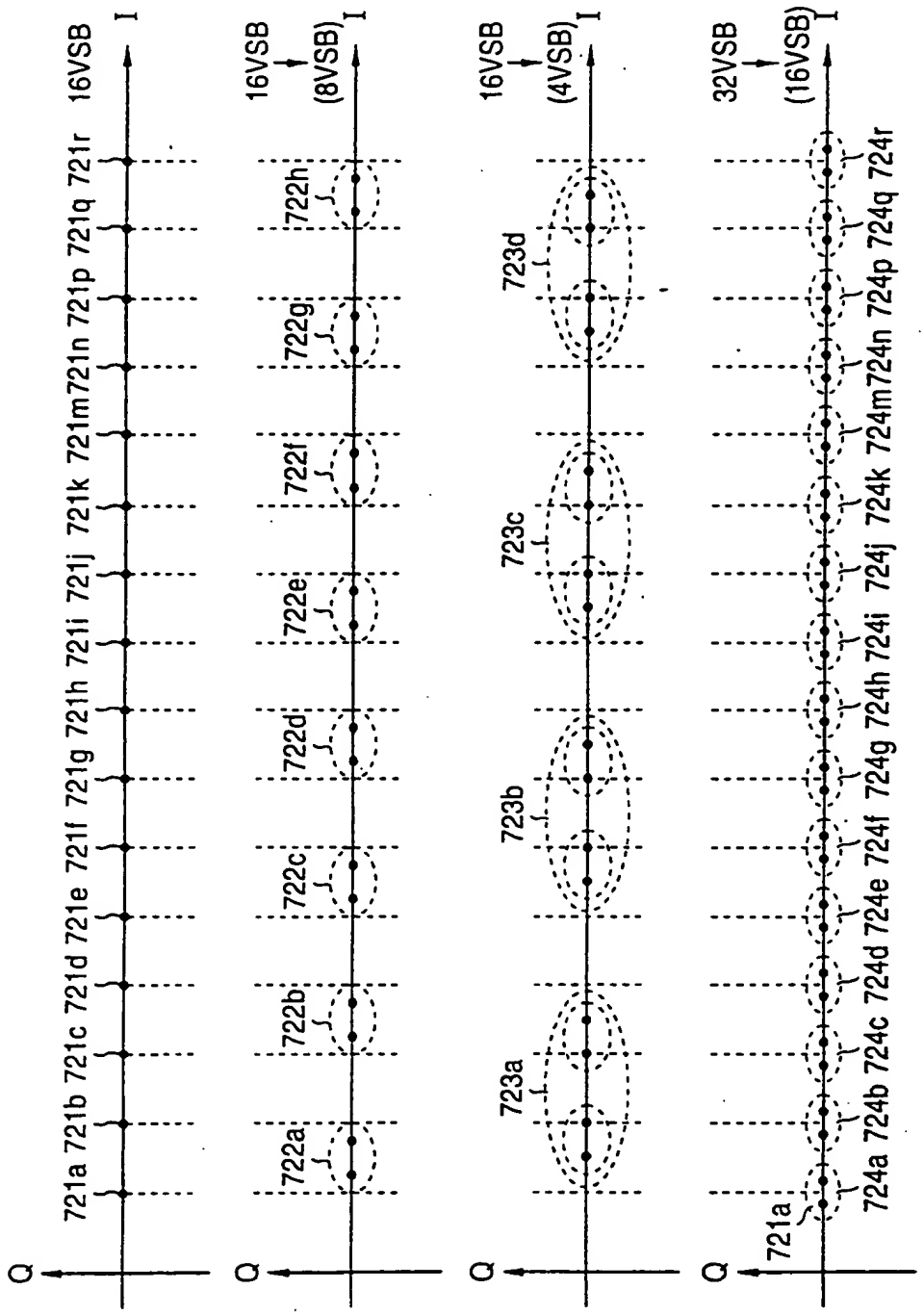


FIG. 159(a)

FIG. 159(b)

FIG. 159(c)

FIG. 159(d)

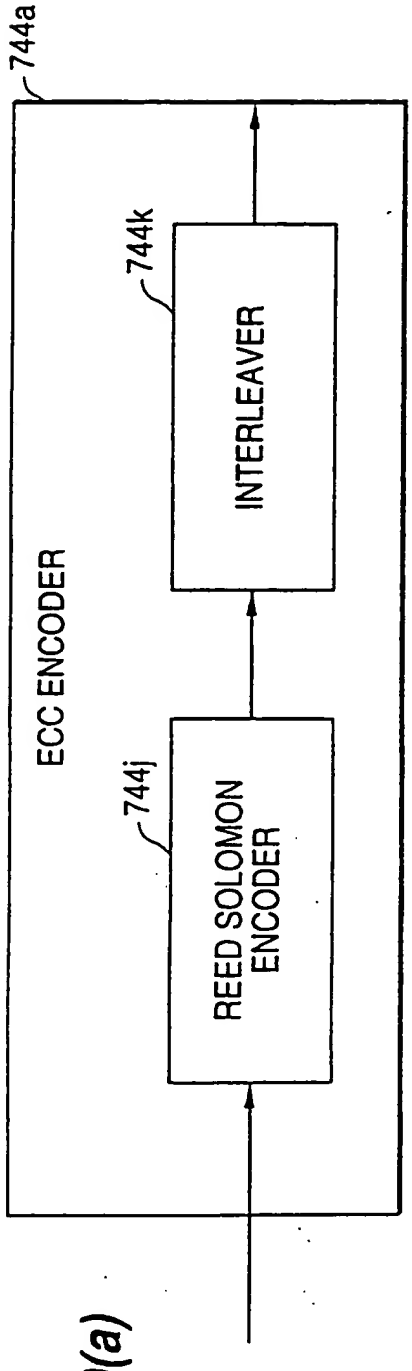


FIG. 160(a)

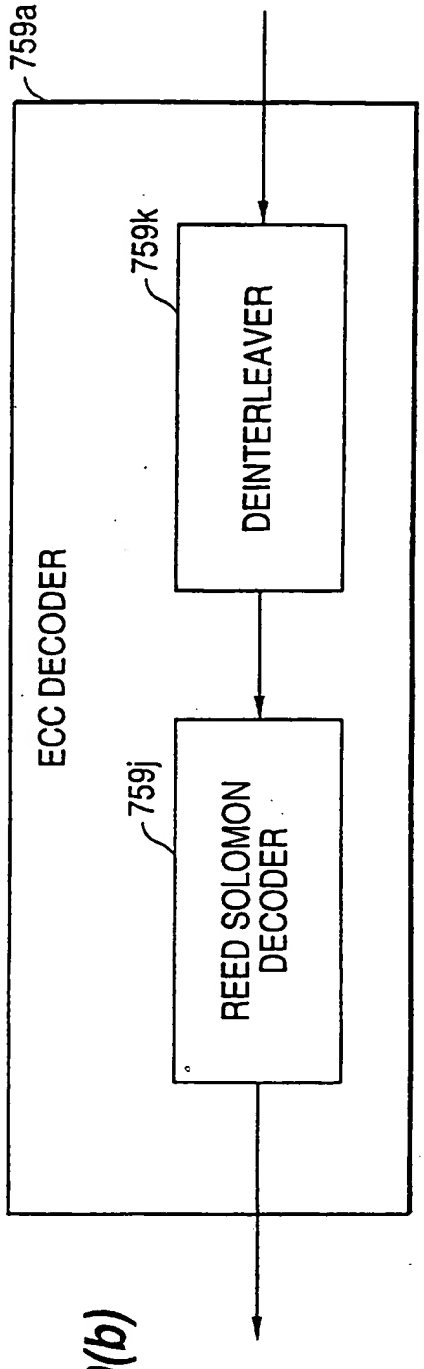


FIG. 160(b)

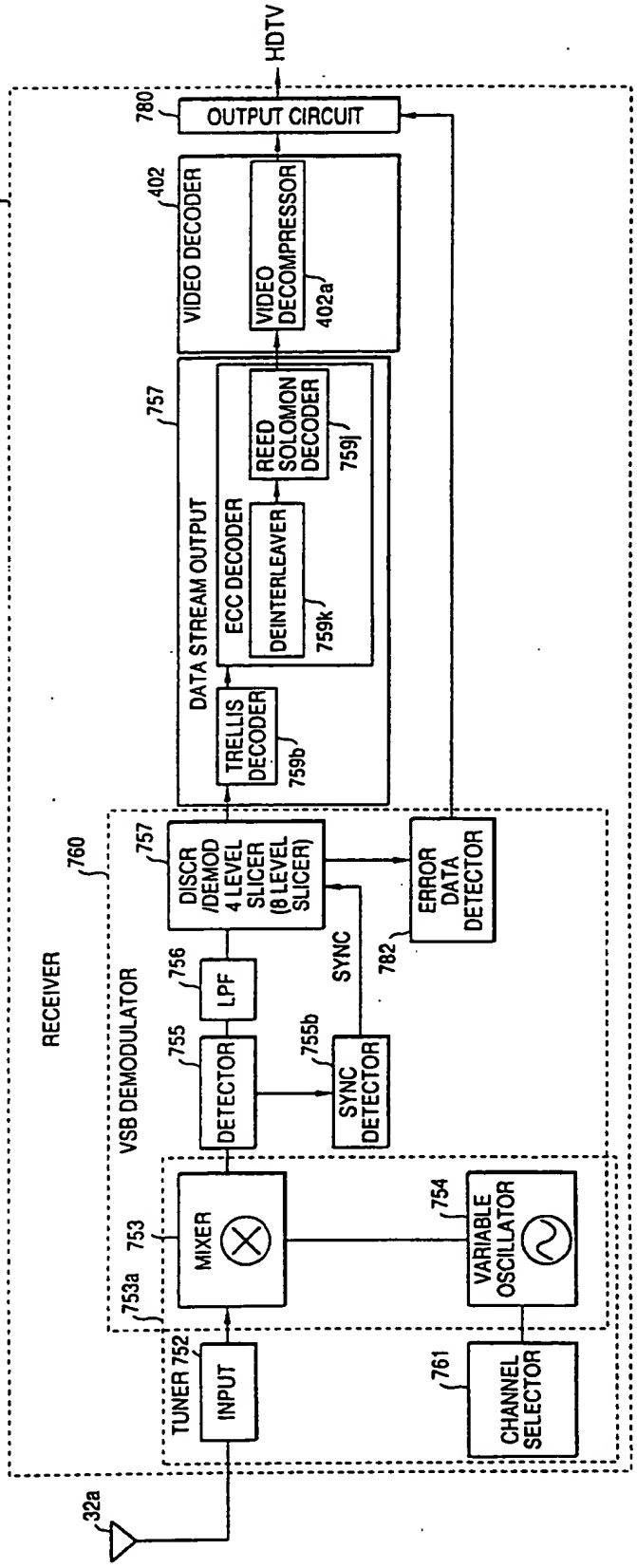

HDTV
780
OUTPUT CIRCUIT
751
402
VIDEO DECODER
VIDEO DECOMPRESSOR
402a
757
DATA STREAM OUTPUT
ECC DECODER
REED SOLOMON DECODER
759j
DEINTERLEAVER
759k
TRELLIS DECODER
759b
760
RECEIVER
VSB DEMODULATOR
DISCR /DEMOD 4 LEVEL SLICER (8 LEVEL SLICER)
ERROR DATA DETECTOR
782
SYNC
756
LPF
755
DETECTOR
755b
SYNC DETECTOR
753
753a
MIXER
754
VARIABLE OSCILLATOR
TUNER 752
INPUT
761
CHANNEL SELECTOR
32a

FIG. 161

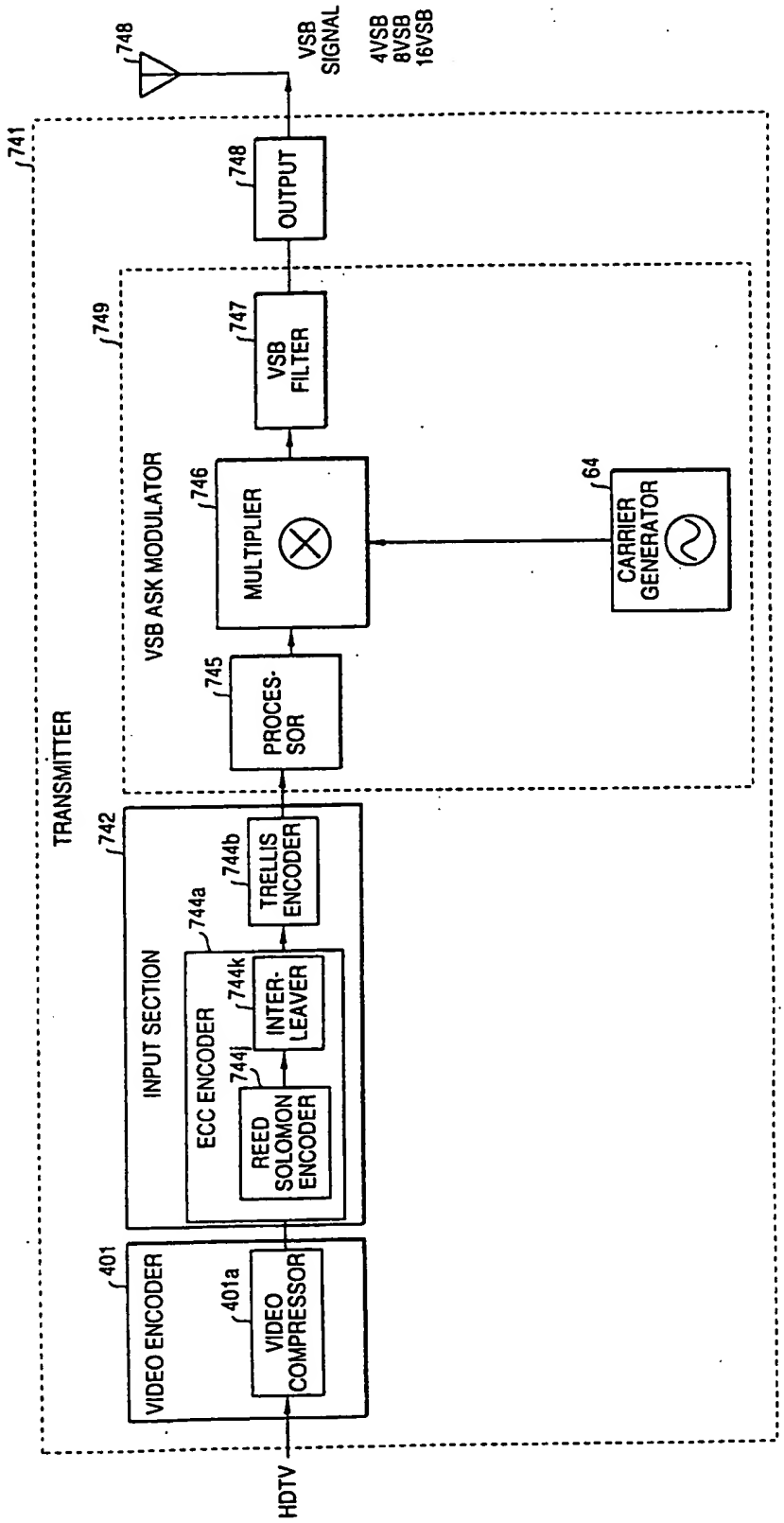

748
VSB SIGNAL
4VSB
8VSB
16VSB
741
748
OUTPUT
749
747
VSB FILTER
VSB ASK MODULATOR
746
MULTIPLIER
64
CARRIER GENERATOR
745
PROCES-SOR
TRANSMITTER
742
744b
TRELLIS ENCODER
744a
INPUT SECTION
744k
INTER-LEAVER
ECC ENCODER
744j
REED SOLOMON ENCODER
401
VIDEO ENCODER
401a
VIDEO COMPRESSOR
HDTV

FIG. 162

FIG. 163

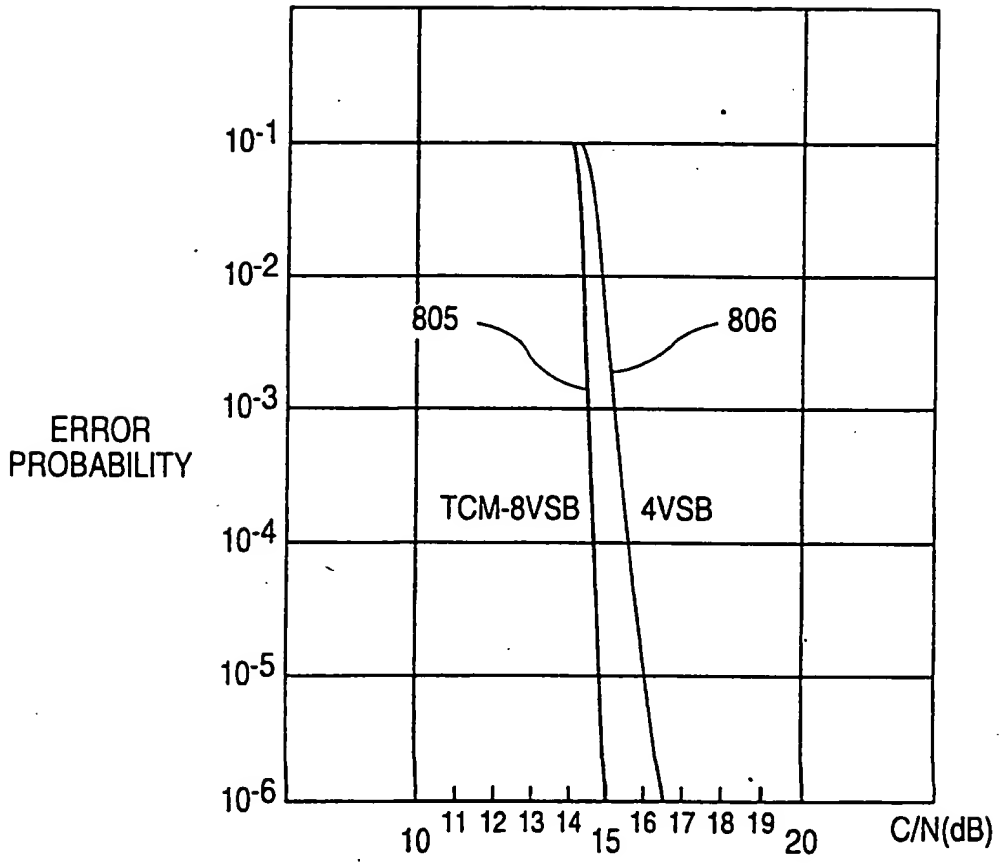

ERROR PROBABILITY
10-1
10-2
10-3
10-4
10-5
10-6
805
806
TCM-8VSB
4VSB
10 11 12 13 14 15 16 17 18 19 20
C/N(dB)

FIG. 164

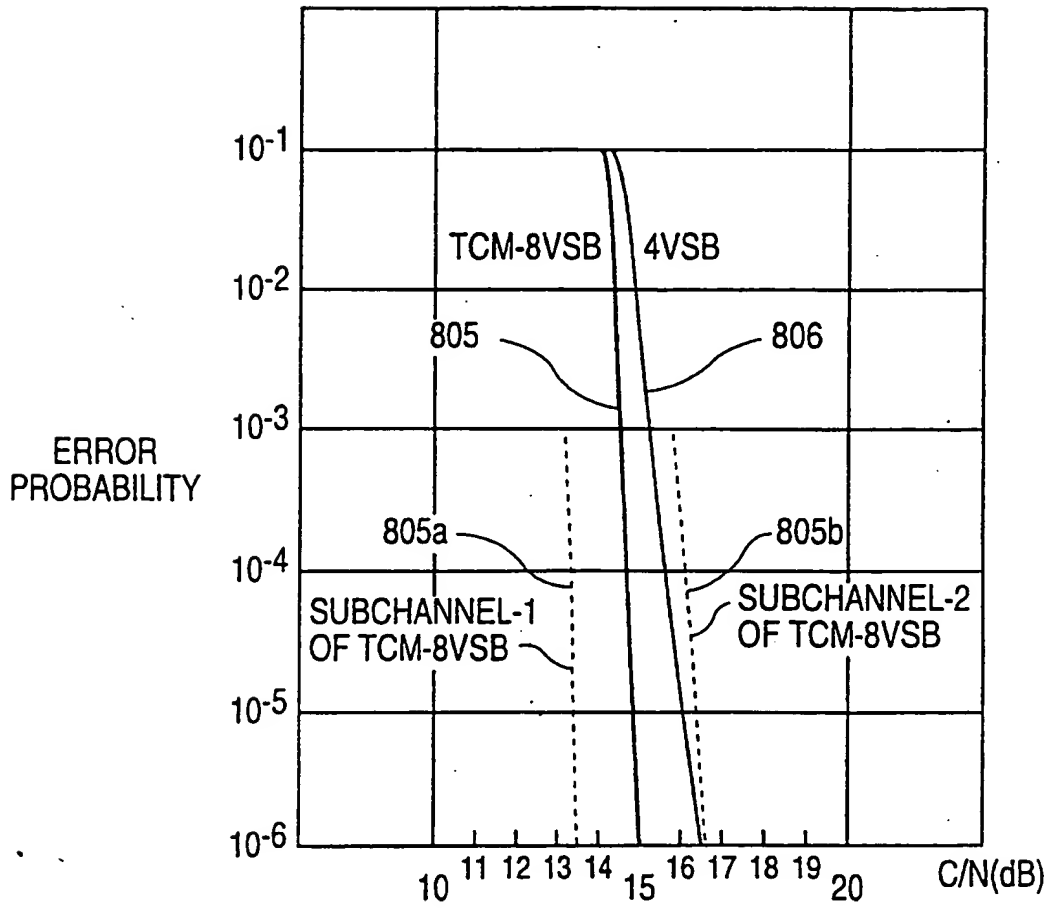

ERROR PROBABILITY
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
TCM-8VSB
4VSB
805
806
805a
805b
SUBCHANNEL-1 OF TCM-8VSB
SUBCHANNEL-2 OF TCM-8VSB
10 11 12 13 14 15 16 17 18 19 20
C/N(dB)

FIG. 165(a)

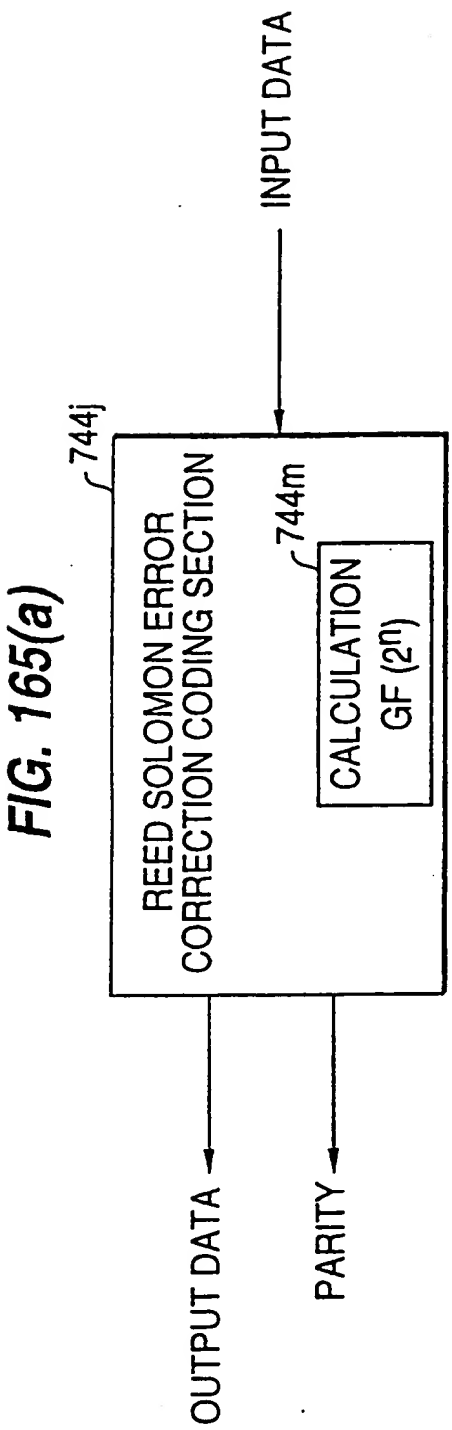


FIG. 165(b)

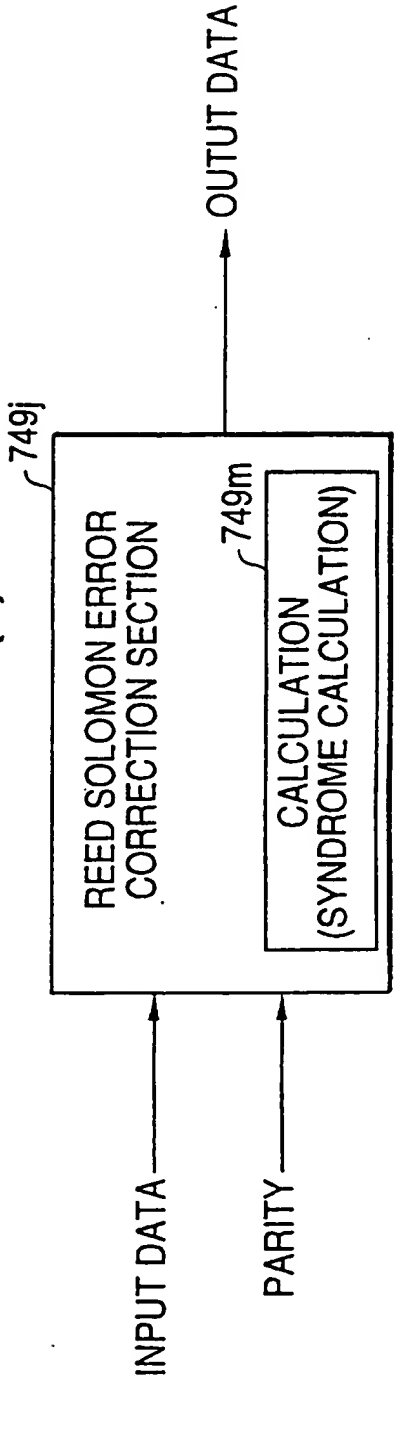
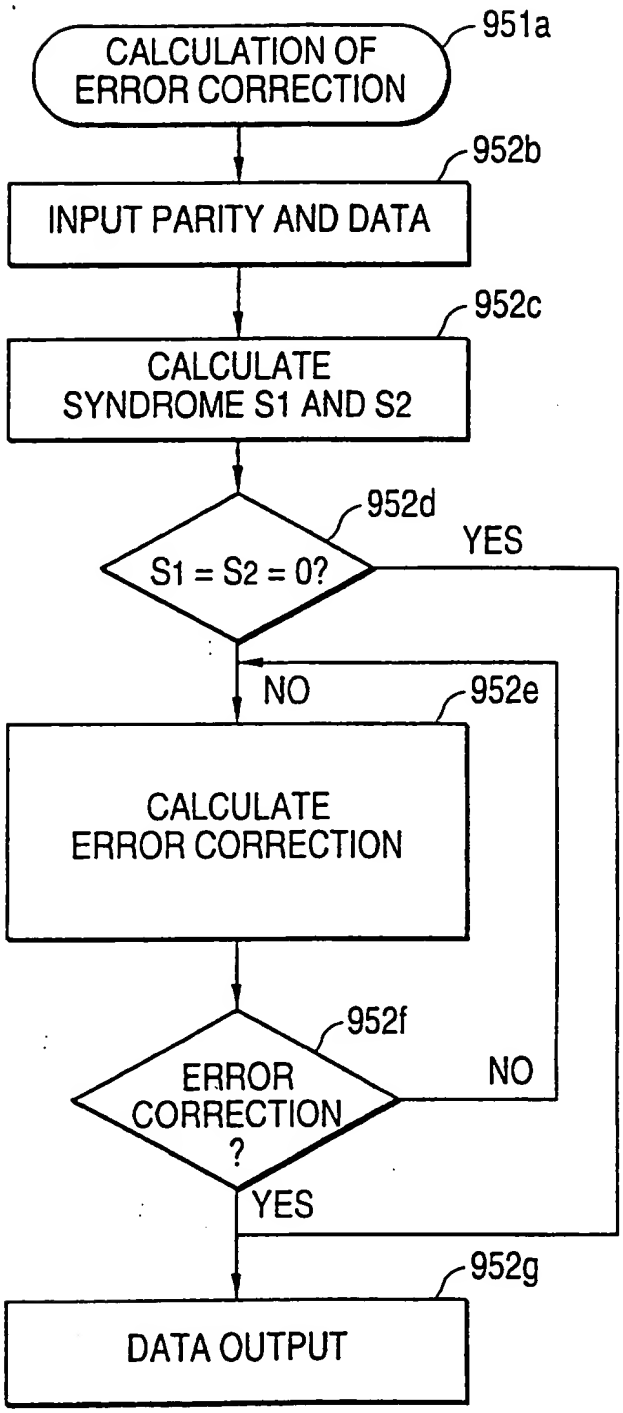


FIG. 166


CALCULATION OF ERROR CORRECTION
951a
INPUT PARITY AND DATA
952b
CALCULATE SYNDROME S1 AND S2
952c
S1 = S2 = 0?
952d
YES
NO
CALCULATE ERROR CORRECTION
952e
ERROR CORRECTION ?
952f
NO
YES
DATA OUTPUT
952g

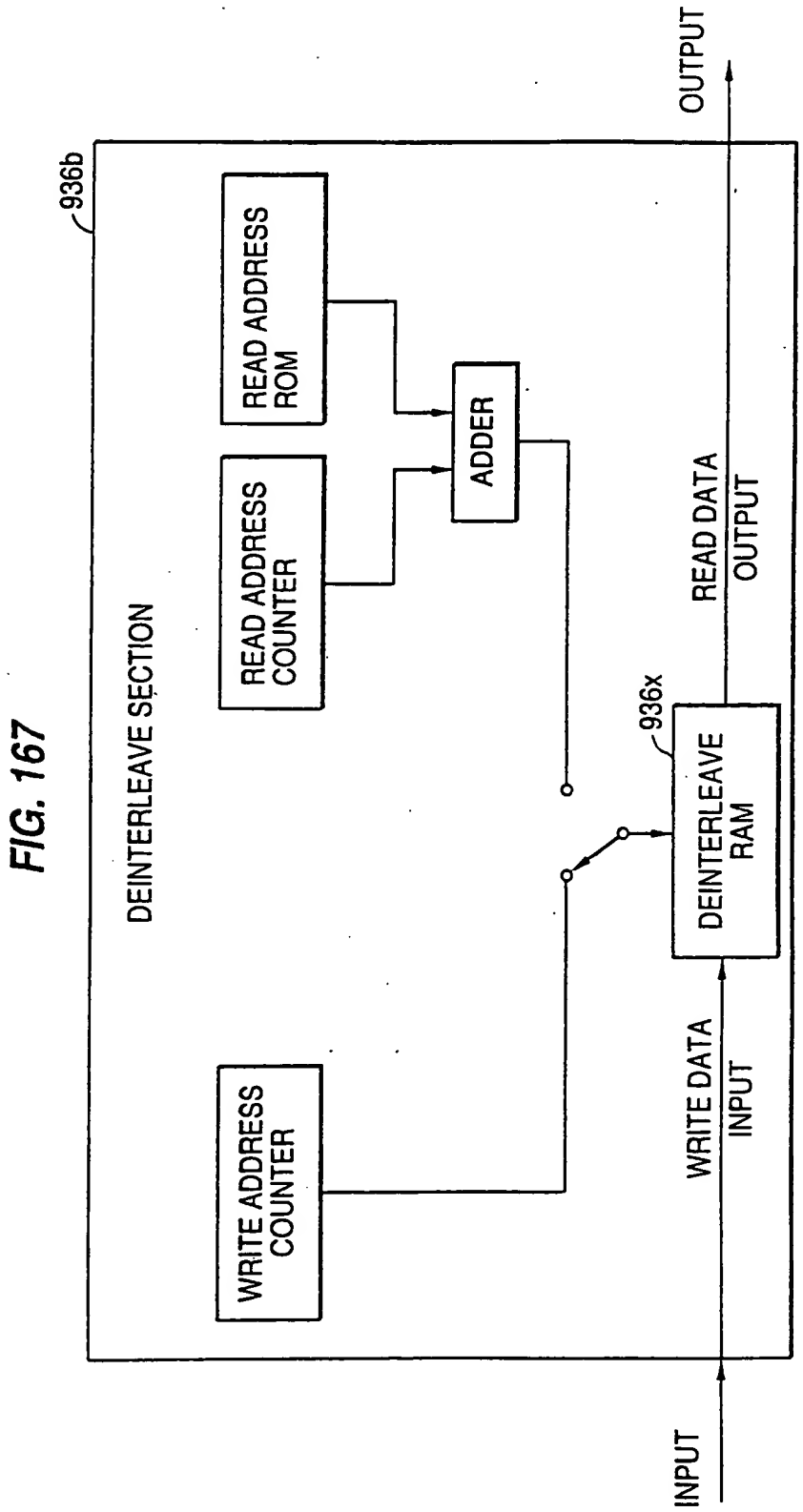

OUTPUT
936b
READ ADDRESS ROM
ADDER
READ ADDRESS COUNTER
DEINTERLEAVE SECTION
READ DATA OUTPUT
936x
DEINTERLEAVE RAM
WRITE ADDRESS COUNTER
WRITE DATA INPUT
INPUT

FIG. 167

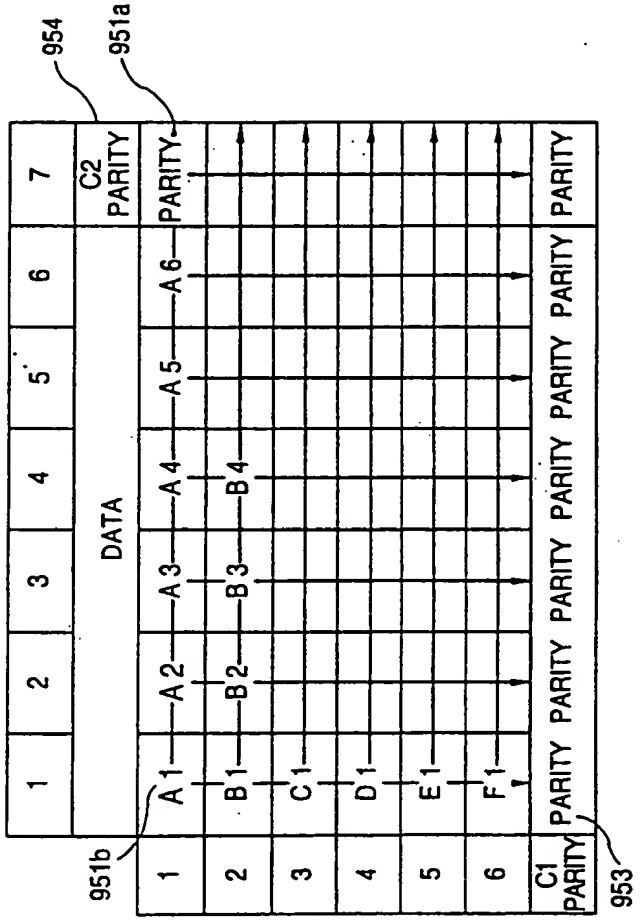


FIG. 168(a)

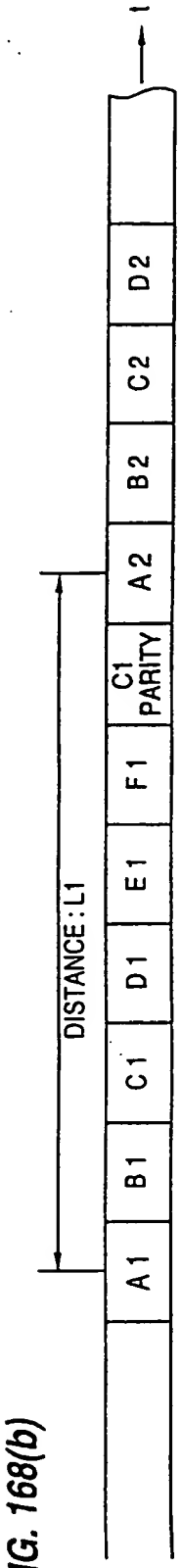


FIG. 168(b)

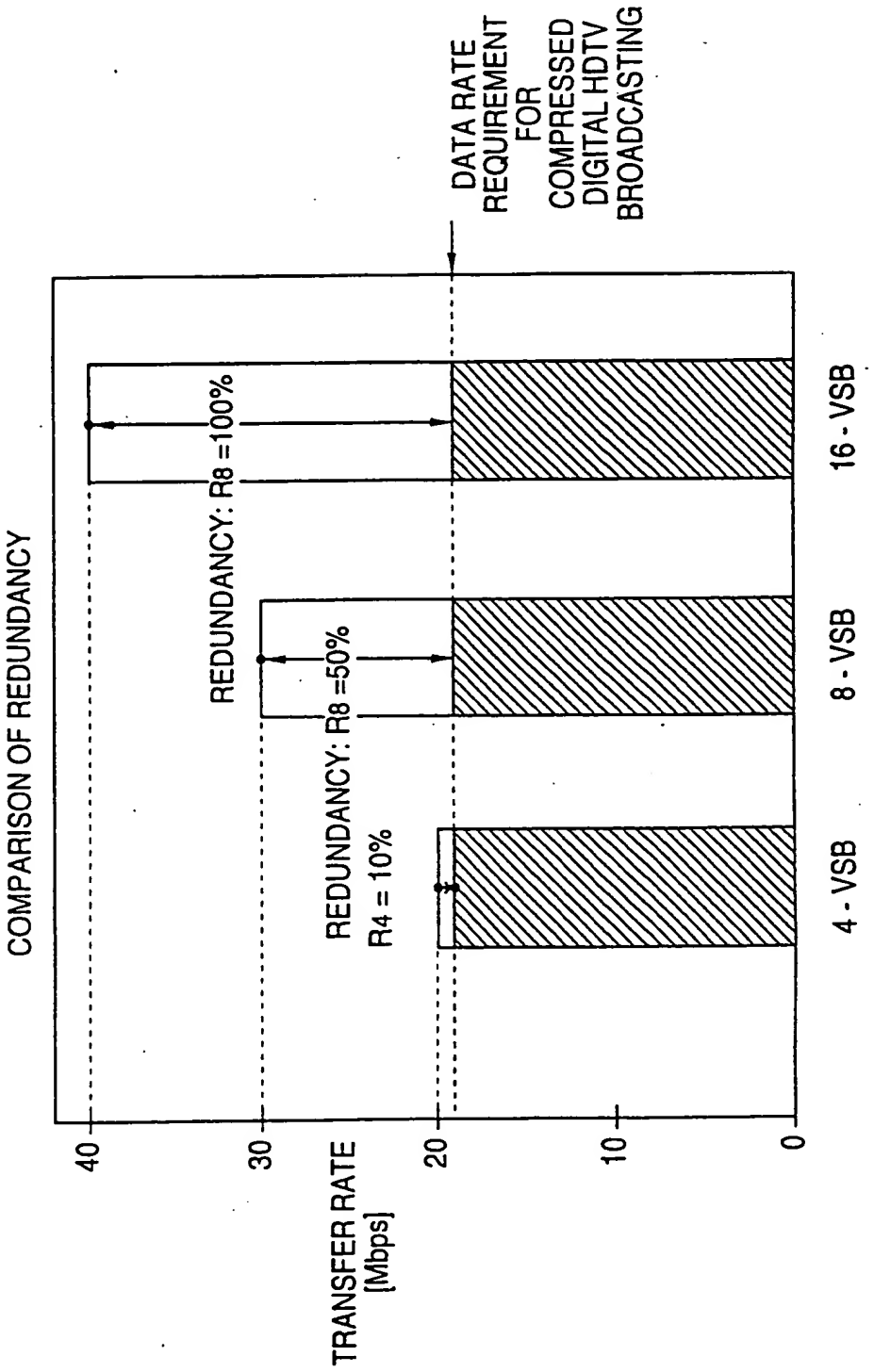
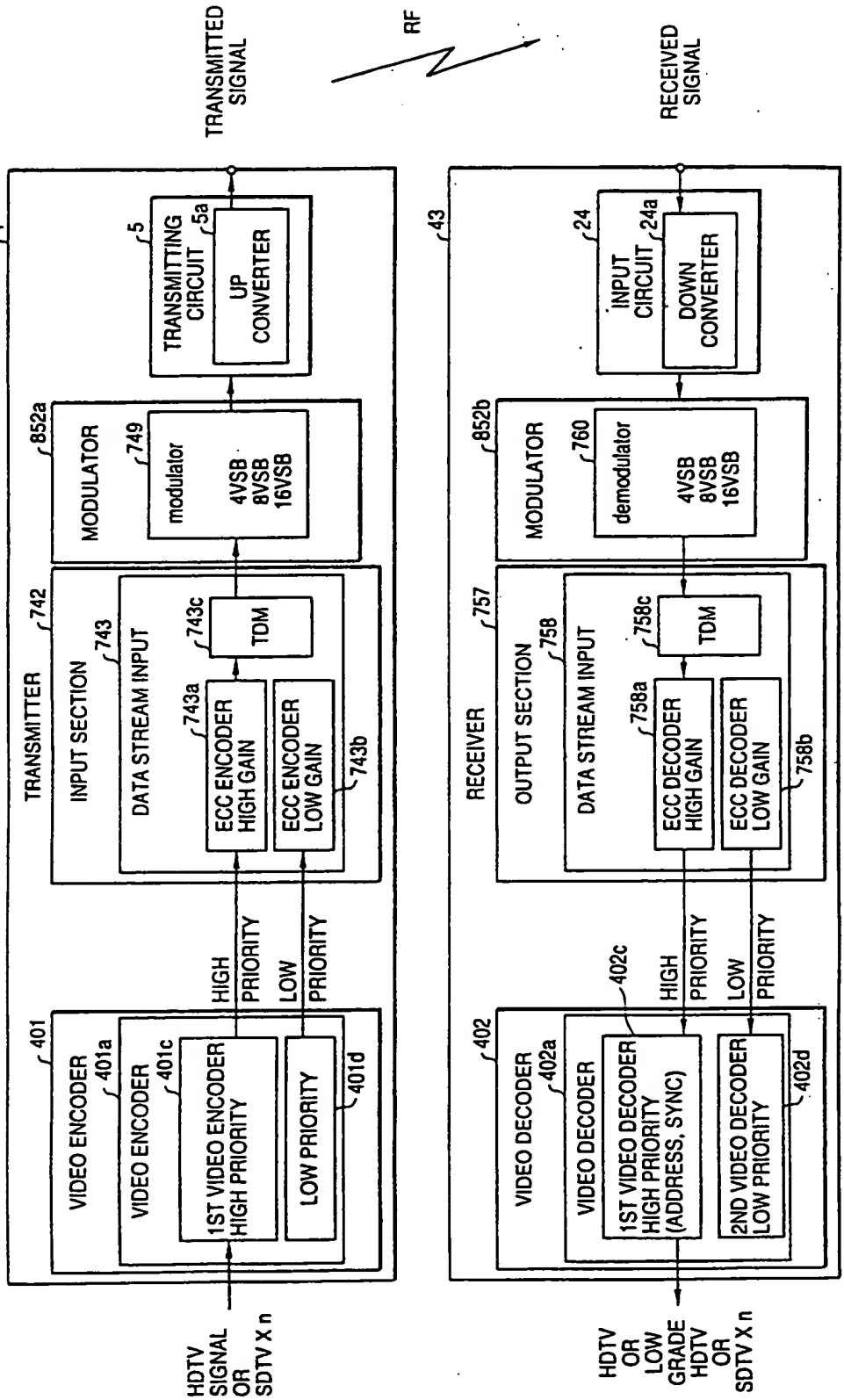

DATA RATE REQUIREMENT FOR COMPRESSED DIGITAL HDTV BROADCASTING
COMPARISON OF REDUNDANCY
REDUNDANCY: R8 =100%
REDUNDANCY: R8 =50%
REDUNDANCY: R4 = 10%
16 - VSB
8 - VSB
4 - VSB
TRANSFER RATE [Mbps]
40
30
20
10
0

FIG. 169

FIG. 170


TRANSMITTED SIGNAL
RF
RECEIVED SIGNAL
1
TRANSMITTER
VIDEO ENCODER
401a
VIDEO ENCODER
401c
1ST VIDEO ENCODER HIGH PRIORITY
LOW PRIORITY
401d
401
HIGH PRIORITY
LOW PRIORITY
INPUT SECTION
743
DATA STREAM INPUT
743a
ECC ENCODER HIGH GAIN
ECC ENCODER LOW GAIN
743b
743c
TDM
742
MODULATOR
852a
749
modulator
4VSB 8VSB 16VSB
5
TRANSMITTING CIRCUIT
5a
UP CONVERTER
HDTV SIGNAL OR SDTV X n
43
RECEIVER
VIDEO DECODER
402a
VIDEO DECODER
402c
1ST VIDEO DECODER HIGH PRIORITY (ADDRESS, SYNC)
2ND VIDEO DECODER LOW PRIORITY
402d
402
HIGH PRIORITY
LOW PRIORITY
OUTPUT SECTION
758
DATA STREAM INPUT
758a
ECC DECODER HIGH GAIN
ECC DECODER LOW GAIN
758b
758c
TDM
757
MODULATOR
852b
760
demodulator
4VSB 8VSB 16VSB
24
INPUT CIRCUIT
24a
DOWN CONVERTER
HDTV OR LOW GRADE HDTV OR SDTV X n

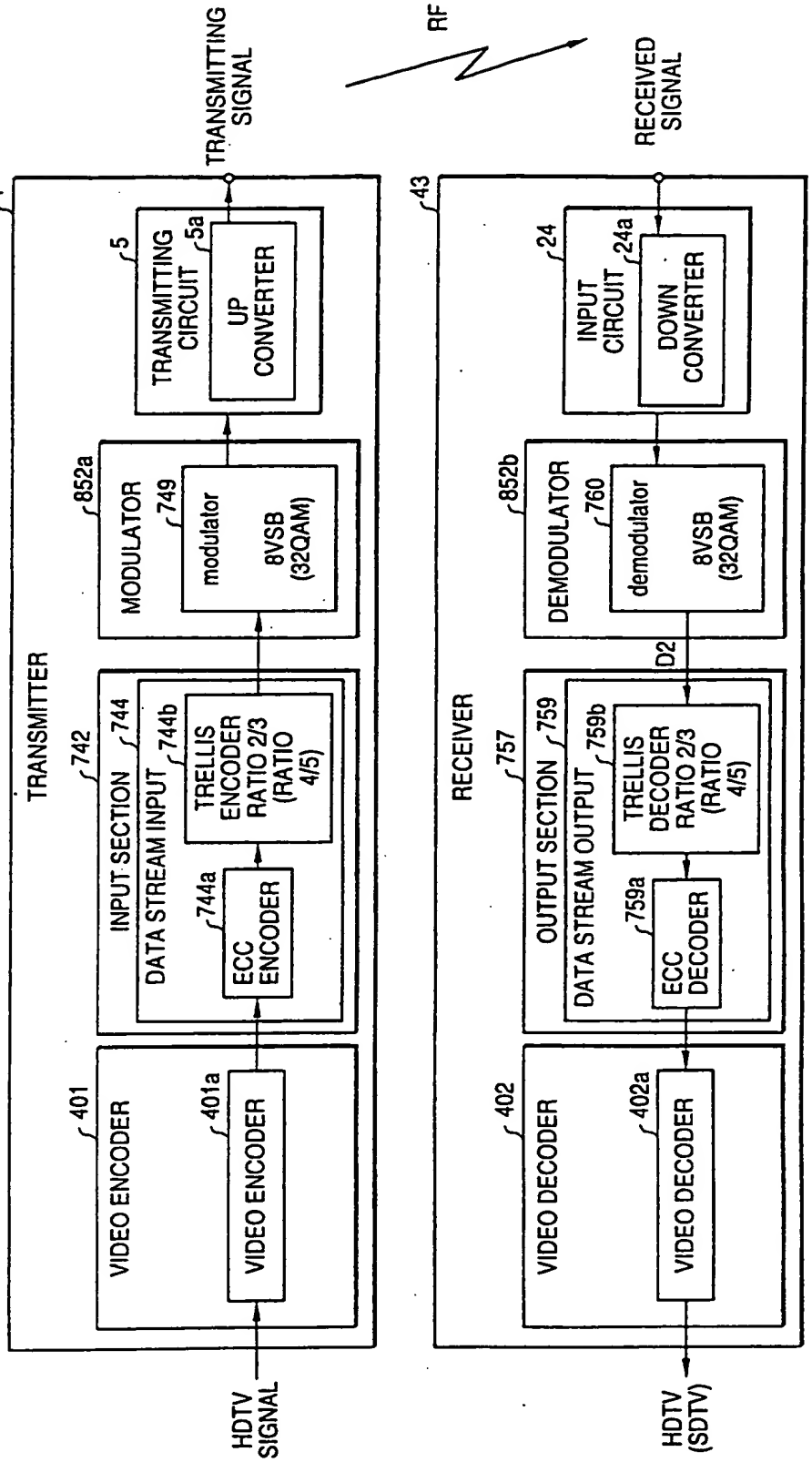
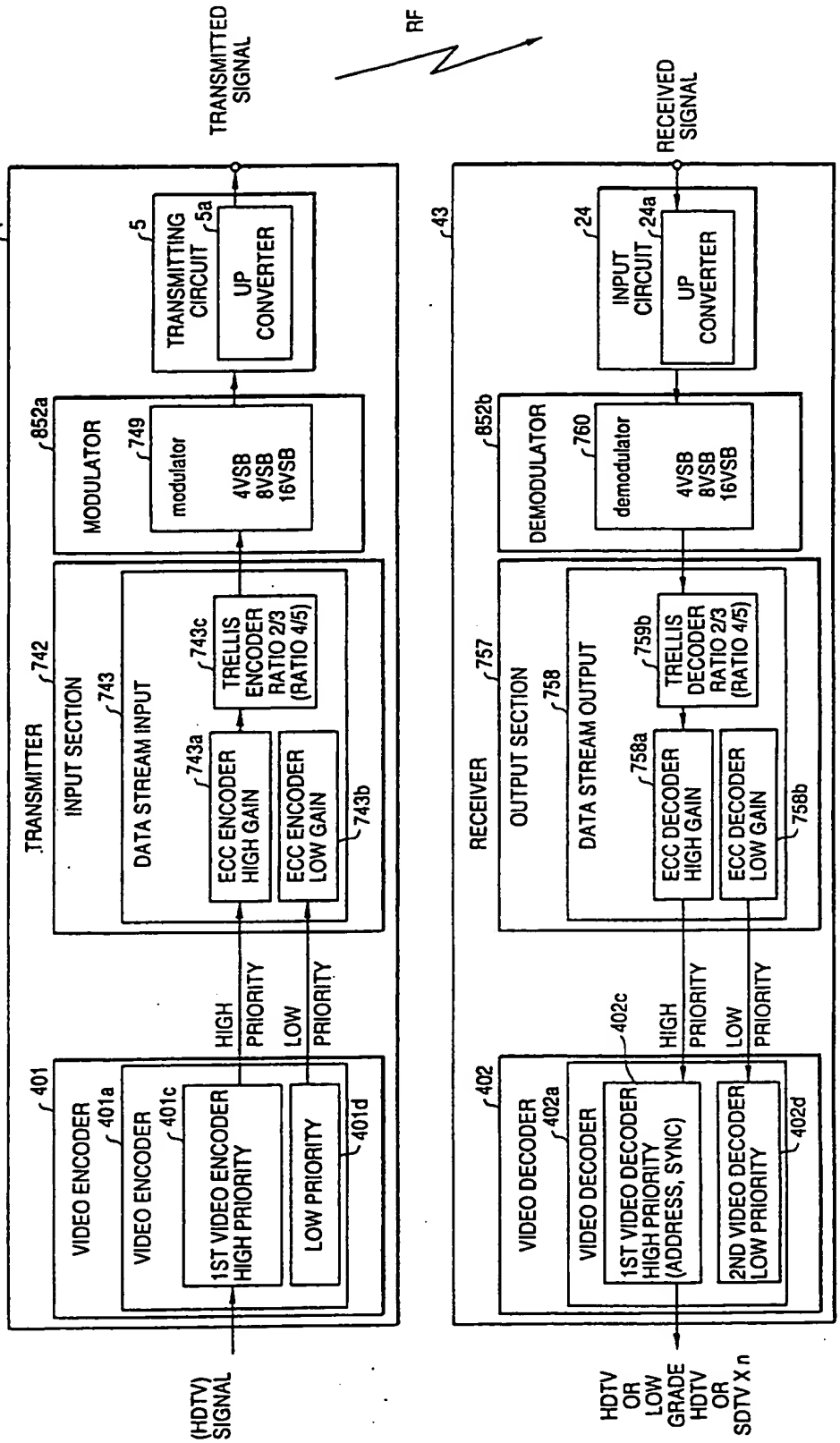

TRANSMITTING SIGNAL
RF
RECEIVED SIGNAL
1
TRANSMITTER
5
TRANSMITTING CIRCUIT
5a
UP CONVERTER
852a
MODULATOR
749
modulator
8VSB (32QAM)
742
INPUT SECTION
744
DATA STREAM INPUT
744b
TRELLIS ENCODER RATIO 2/3 (RATIO 4/5)
744a
ECC ENCODER
401
VIDEO ENCODER
401a
VIDEO ENCODER
HDTV SIGNAL
43
RECEIVER
24
INPUT CIRCUIT
24a
DOWN CONVERTER
852b
DEMODULATOR
760
demodulator
8VSB (32QAM)
D2
757
OUTPUT SECTION
759
DATA STREAM OUTPUT
759b
TRELLIS DECODER RATIO 2/3 (RATIO 4/5)
759a
ECC DECODER
402
VIDEO DECODER
402a
VIDEO DECODER
HDTV (SDTV)

FIG. 171

FIG. 172


(HDTV) SIGNAL
TRANSMITTER
1
VIDEO ENCODER
401
401a
VIDEO ENCODER
401c
1ST VIDEO ENCODER HIGH PRIORITY
LOW PRIORITY
401d
HIGH PRIORITY
LOW PRIORITY
INPUT SECTION
742
743
DATA STREAM INPUT
743a
ECC ENCODER HIGH GAIN
ECC ENCODER LOW GAIN
743b
743c
TRELLIS ENCODER RATIO 2/3 (RATIO 4/5)
MODULATOR
852a
749
modulator
4VSB 8VSB 16VSB
5
TRANSMITTING CIRCUIT
5a
UP CONVERTER
TRANSMITTED SIGNAL
RF
RECEIVED SIGNAL
43
24
INPUT CIRCUIT
24a
UP CONVERTER
DEMODULATOR
852b
760
demodulator
4VSB 8VSB 16VSB
RECEIVER
757
OUTPUT SECTION
758
DATA STREAM OUTPUT
758a
ECC DECODER HIGH GAIN
ECC DECODER LOW GAIN
758b
759b
TRELLIS DECODER RATIO 2/3 (RATIO 4/5)
402
VIDEO DECODER
402a
VIDEO DECODER
402c
1ST VIDEO DECODER HIGH PRIORITY (ADDRESS, SYNC)
2ND VIDEO DECODER LOW PRIORITY
402d
HIGH PRIORITY
LOW PRIORITY
HDTV OR LOW GRADE HDTV OR SDTV X n

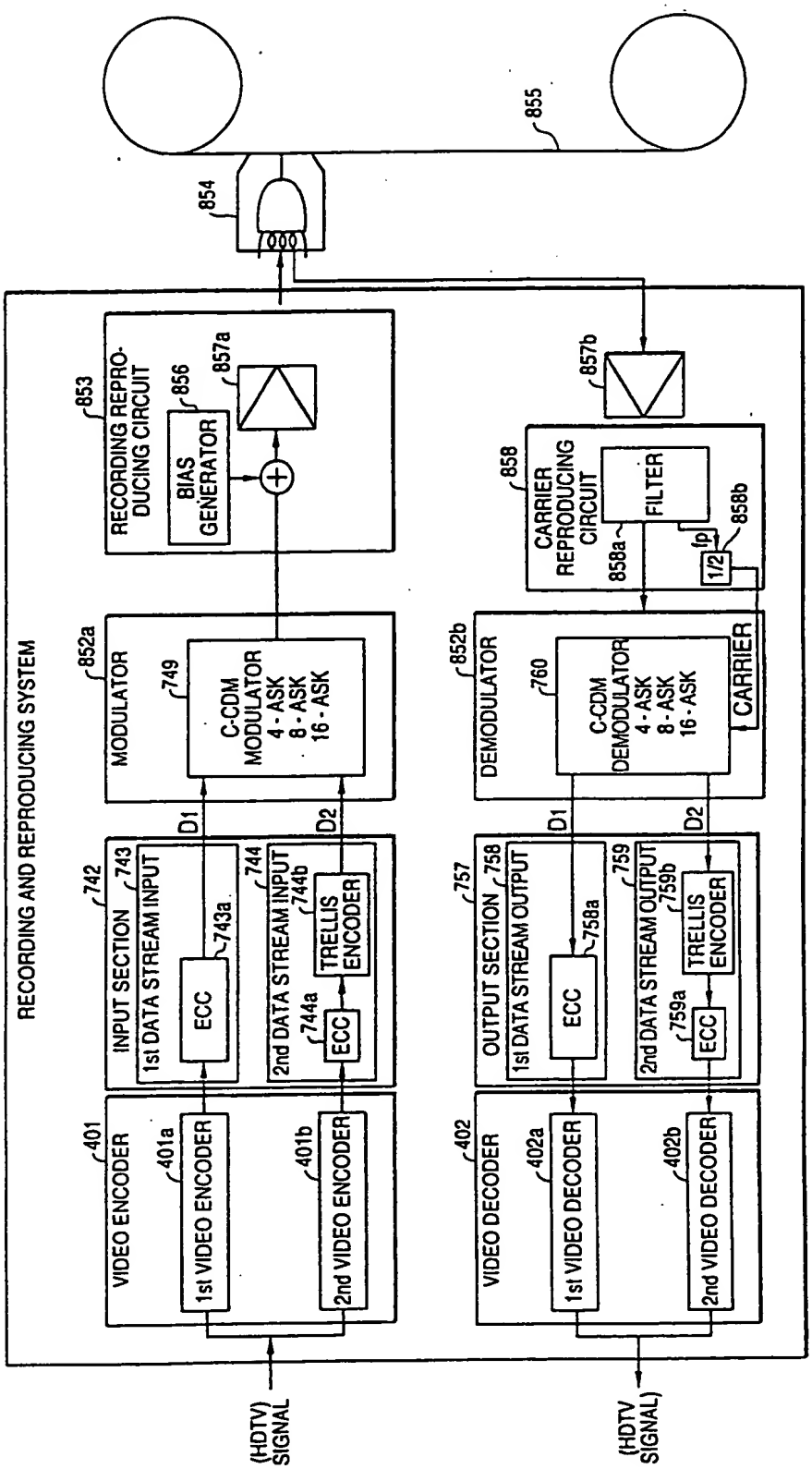

RECORDING AND REPRODUCING SYSTEM
(HDTV SIGNAL)
VIDEO ENCODER
401
1st VIDEO ENCODER
401a
2nd VIDEO ENCODER
401b
INPUT SECTION
742
1st DATA STREAM INPUT
743
ECC
743a
2nd DATA STREAM INPUT
744
744b
TRELLIS ENCODER
ECC
744a
MODULATOR
852a
749
C-CDM MODULATOR
4 - ASK
8 - ASK
16 - ASK
D1
D2
RECORDING REPRODUCING CIRCUIT
853
BIAS GENERATOR
856
857a
854
855
857b
CARRIER REPRODUCING CIRCUIT
858
FILTER
858a
858b
1p
1/2
DEMODULATOR
852b
760
C-CDM DEMODULATOR
4 - ASK
8 - ASK
16 - ASK
CARRIER
OUTPUT SECTION
757
1st DATA STREAM OUTPUT
758
ECC
758a
2nd DATA STREAM OUTPUT
759
759b
TRELLIS ENCODER
ECC
759a
VIDEO DECODER
402
1st VIDEO DECODER
402a
2nd VIDEO DECODER
402b
(HDTV SIGNAL)

FIG. 173

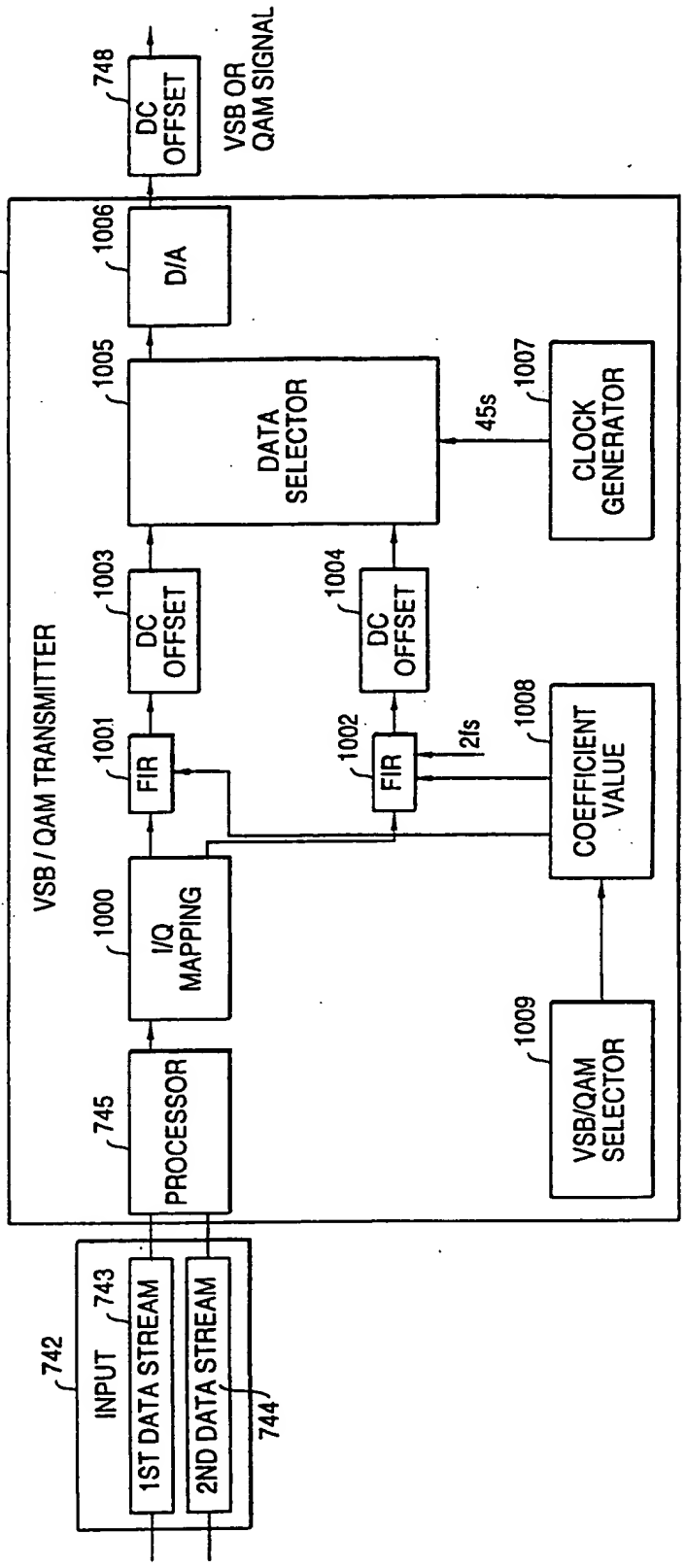

748
DC OFFSET
VSB OR QAM SIGNAL
479
1006
D/A
1005
DATA SELECTOR
45s
1007
CLOCK GENERATOR
1003
DC OFFSET
1004
DC OFFSET
VSB / QAM TRANSMITTER
1001
FIR
1002
FIR
2fs
1008
COEFFICIENT VALUE
1000
I/Q MAPPING
745
PROCESSOR
1009
VSB/QAM SELECTOR
742
INPUT
743
1ST DATA STREAM
744
2ND DATA STREAM

FIG. 174

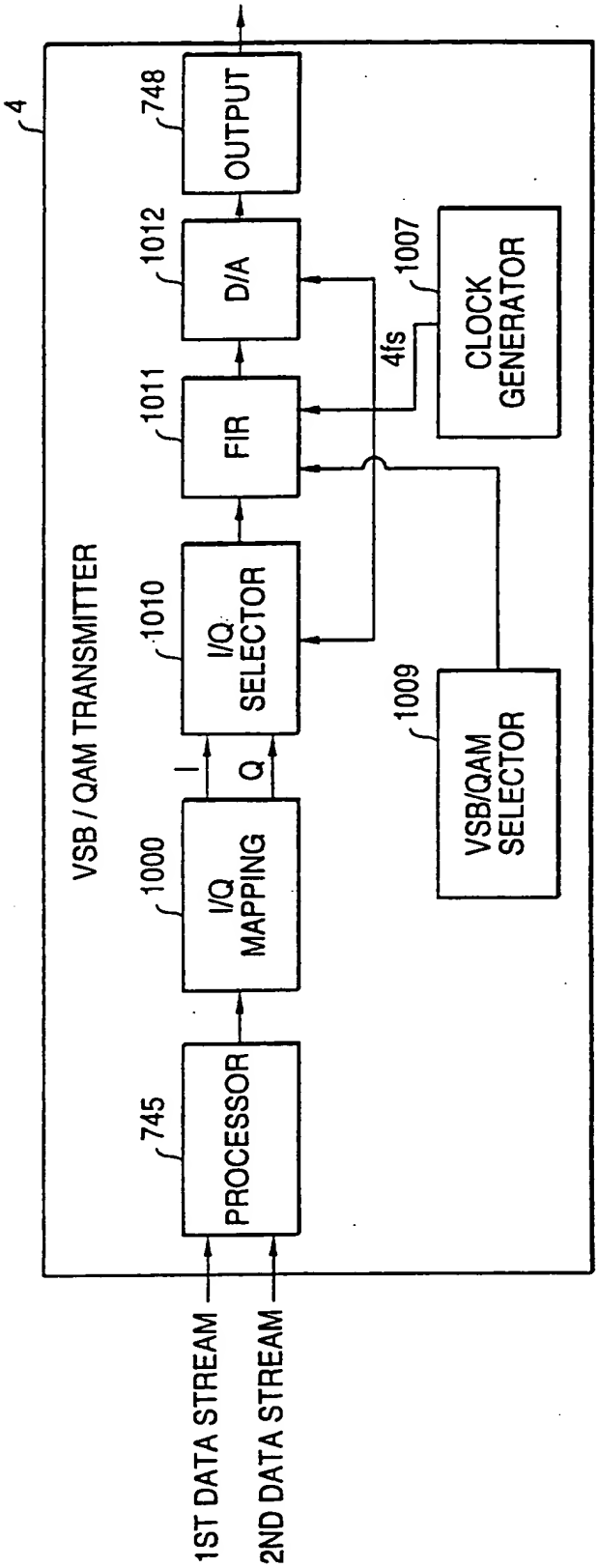

4
VSB / QAM TRANSMITTER
745
PROCESSOR
1000
I/Q MAPPING
I
Q
1010
I/Q SELECTOR
1011
FIR
1012
D/A
748
OUTPUT
1009
VSB/QAM SELECTOR
4fs
1007
CLOCK GENERATOR
1ST DATA STREAM
2ND DATA STREAM

FIG. 175

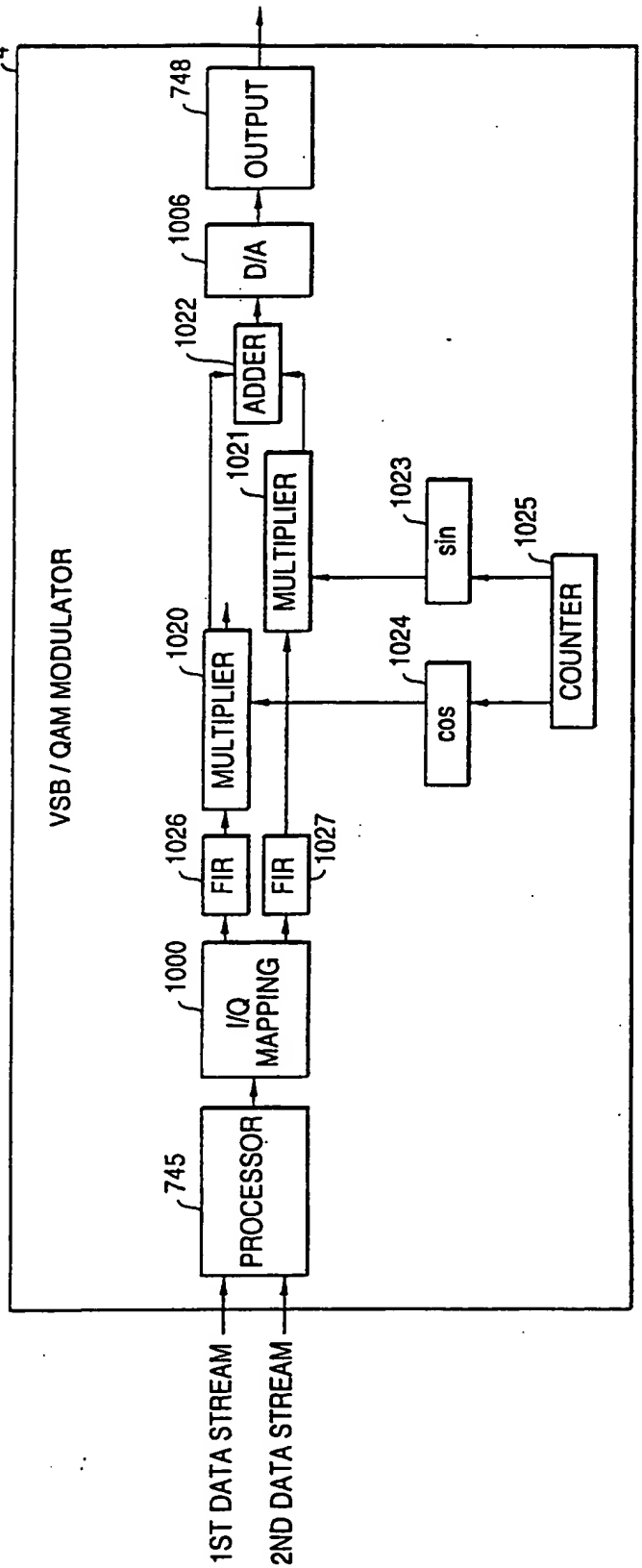
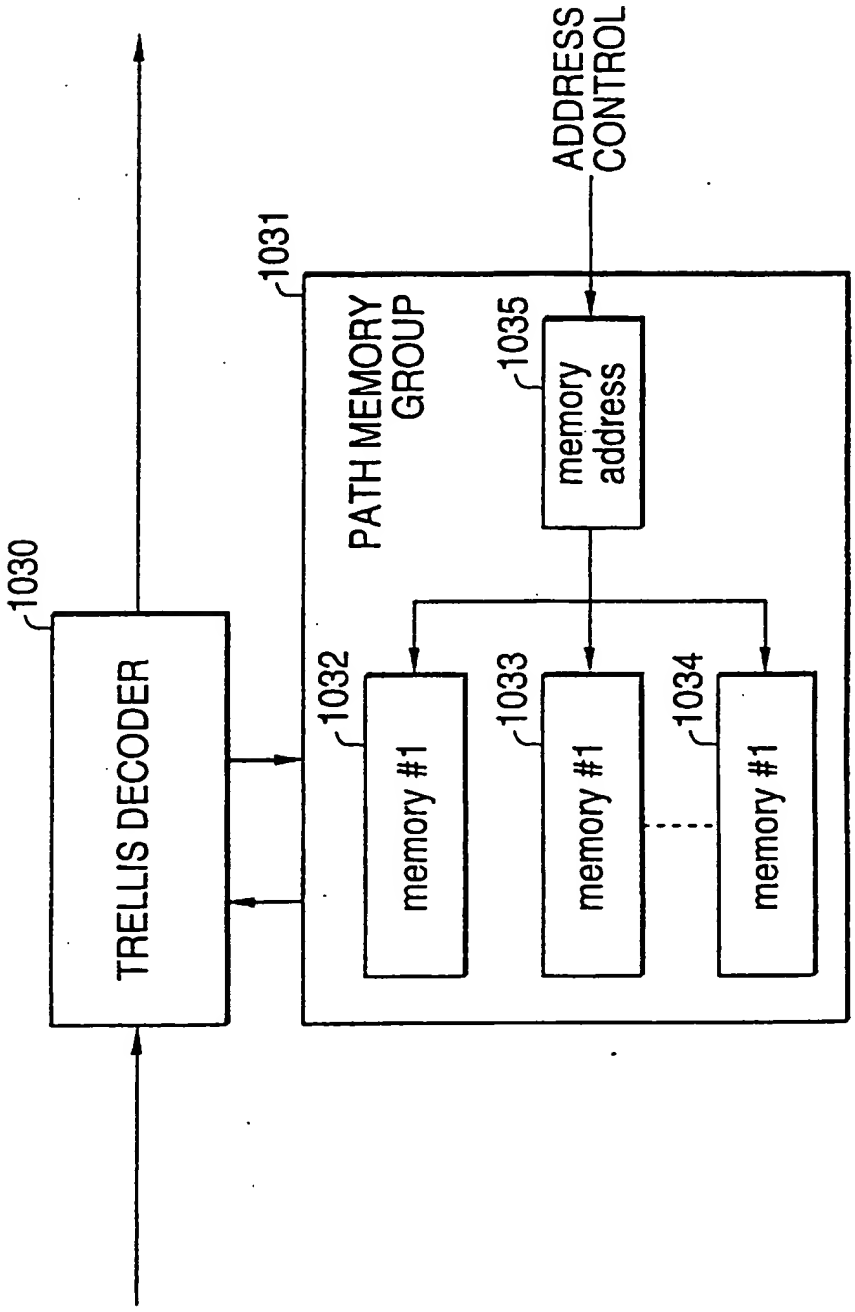

4
VSB / QAM MODULATOR
1ST DATA STREAM
2ND DATA STREAM
745
PROCESSOR
1000
I/Q MAPPING
1026
FIR
1027
FIR
1020
MULTIPLIER
1021
MULTIPLIER
1022
ADDER
1006
D/A
748
OUTPUT
1023
sin
1024
cos
1025
COUNTER

FIG. 176

FIG. 177


ADDRESS CONTROL
1031
PATH MEMORY GROUP
1035
memory address
1030
TRELLIS DECODER
1032
memory #1
1033
memory #1
1034
memory #1

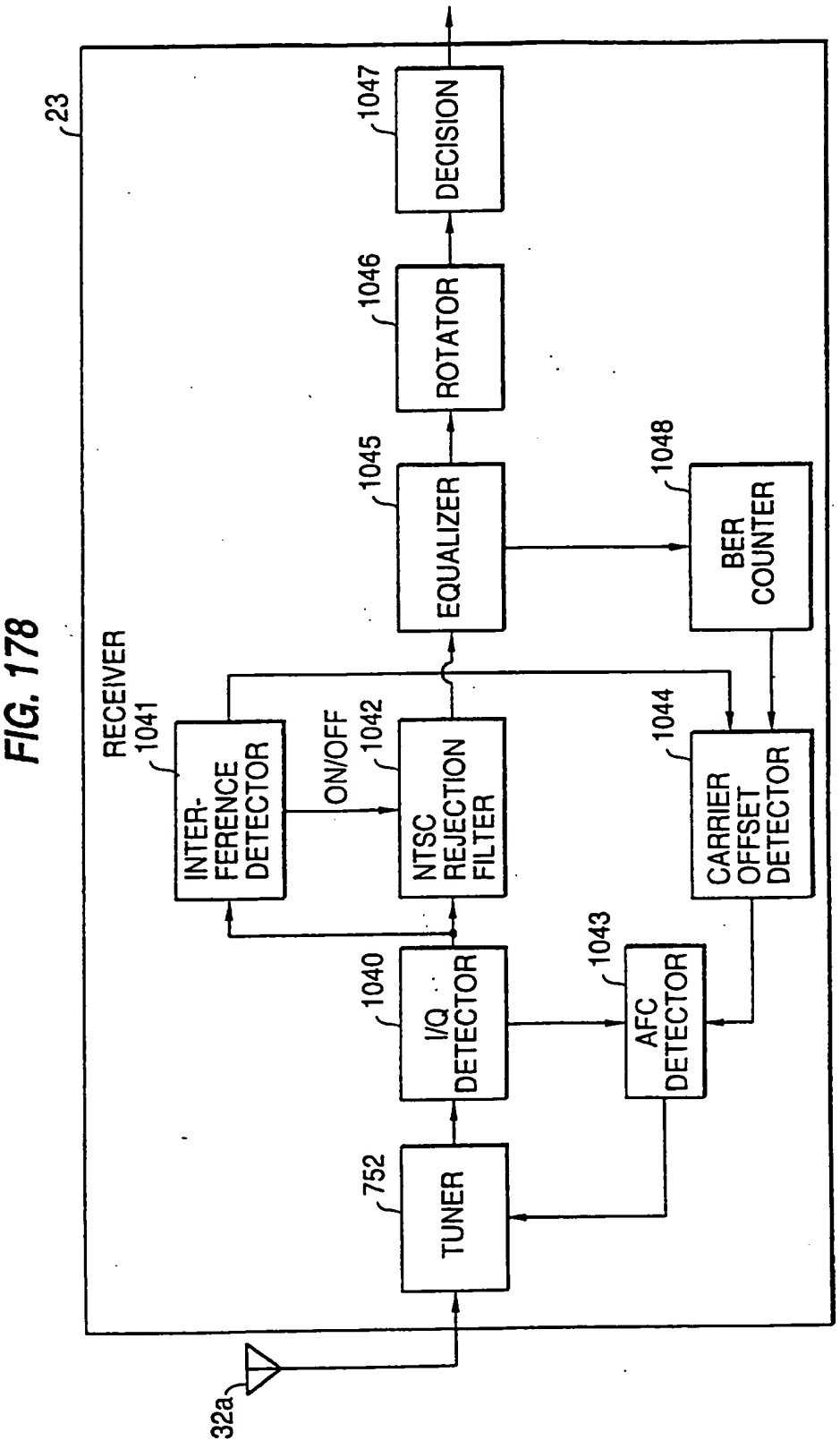

23
RECEIVER
1047
DECISION
1046
ROTATOR
1045
EQUALIZER
1048
BER COUNTER
1041
INTER-FERENCE DETECTOR
ON/OFF
1042
NTSC REJECTION FILTER
1044
CARRIER OFFSET DETECTOR
1040
I/Q DETECTOR
1043
AFC DETECTOR
752
TUNER
32a

FIG. 178

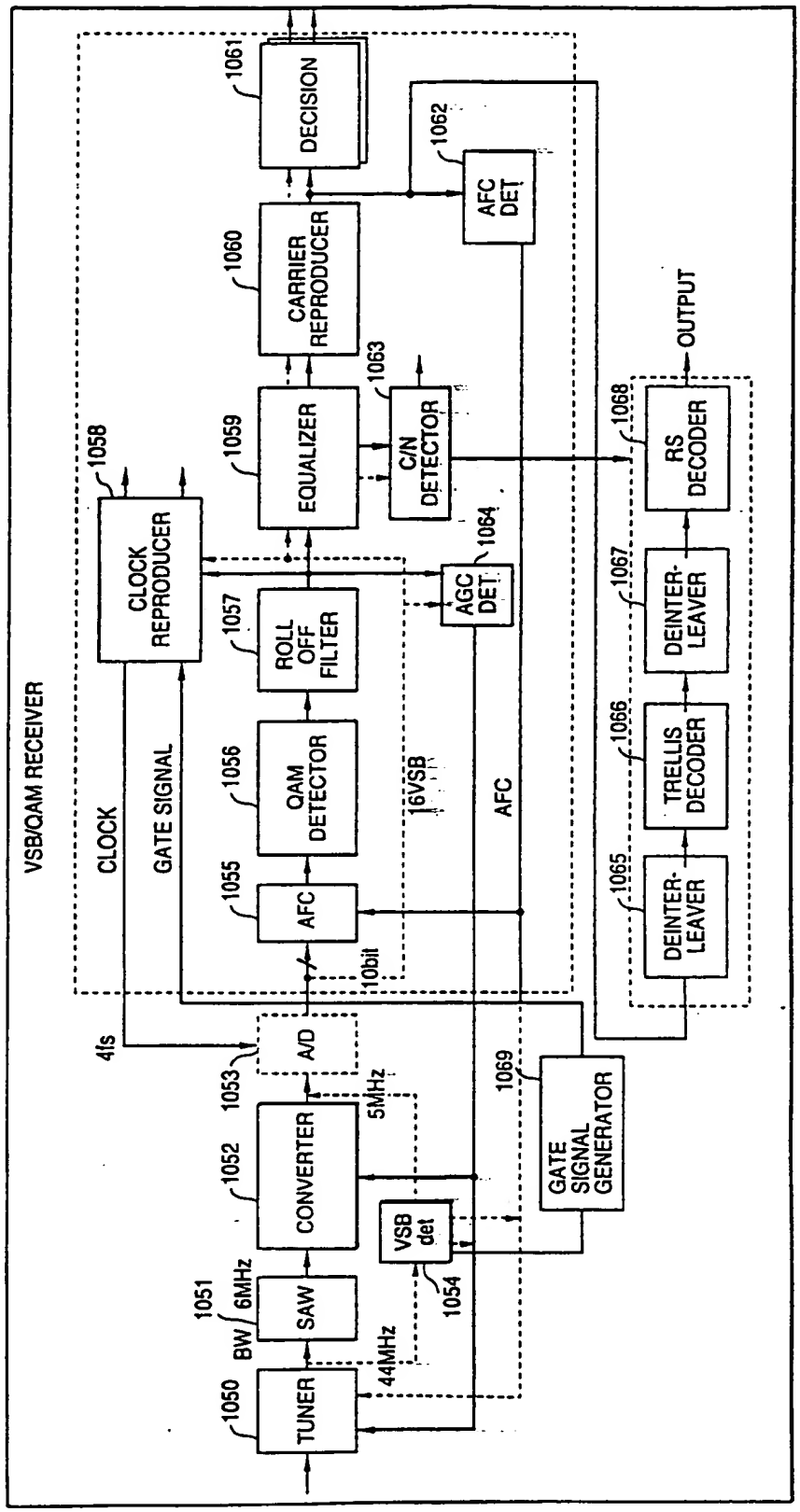

VSB/QAM RECEIVER
TUNER
1050
BW
SAW
6MHz
1051
CONVERTER
1052
A/D
1053
4fs
44MHz
5MHz
VSB det
1054
AFC
1055
QAM DETECTOR
1056
ROLL OFF FILTER
1057
CLOCK REPRODUCER
1058
EQUALIZER
1059
CARRIER REPRODUCER
1060
DECISION
1061
AFC DET
1062
C/N DETECTOR
1063
AGC DET
1064
DEINTER-LEAVER
1065
TRELLIS DECODER
1066
DEINTER-LEAVER
1067
RS DECODER
1068
OUTPUT
GATE SIGNAL GENERATOR
1069
10bit
16VSB
AFC
CLOCK
GATE SIGNAL

FIG. 179

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